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REPORTS

OF THE

SLEEPING SICKNESS COMMISSION

OF THE

ROYAL SOCIETY.

No. VI.

11. **Continuation Report on Sleeping Sickness in Uganda.** By Captain E. D. W. Greig, I.M.S., and Lieutenant A. C. H. Gray, R.A.M.C. (Sleeping Sickness Commission).

12. **Report on Sleeping Sickness in the Nile Valley.** By Captain E. D. W. Greig, I.M.S.

13. **The Distribution of the Tsetse Flies** (*with Map*). By E. E. Austen, F.Z.S.

14. **The Multiplication of the Trypanosoma Gambiense in the Alimentary Canal of Glossina Palpalis.** By Lieutenant A. C. H. Gray, R.A.M.C., and Lieutenant F. M. G. Tulloch, R.A.M.C.

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CONTINUATION REPORT

ON

SLEEPING SICKNESS IN UGANDA.

BY

CAPT. E. D. W. GREIG, I.M.S.

AND

LIEUT. A. C. H. GRAY, R.A.M.C.

(SLEEPING SICKNESS COMMISSION.)

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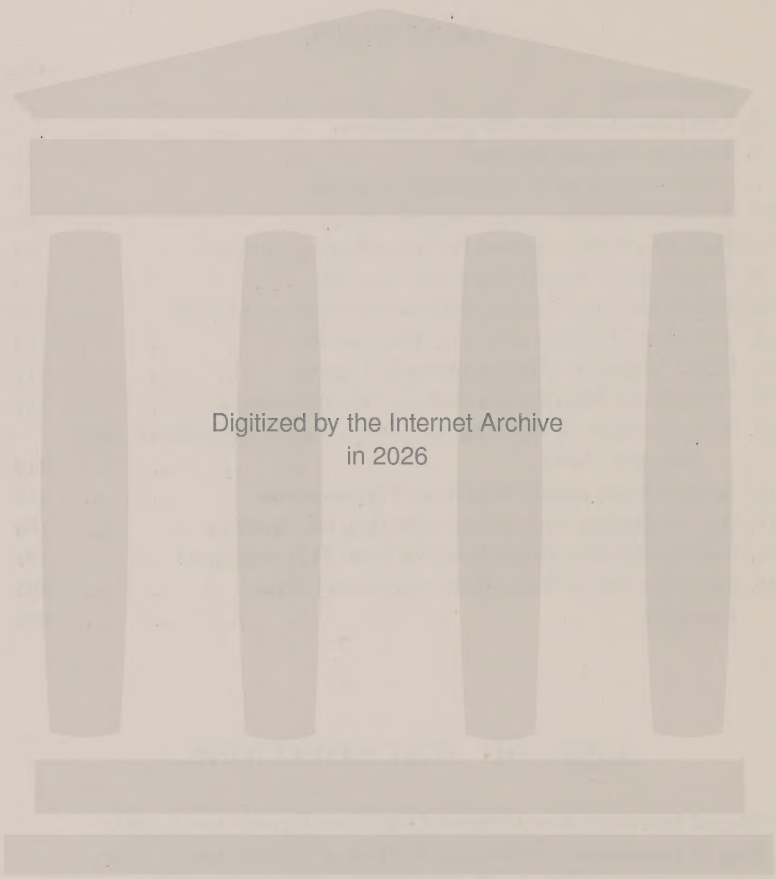

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INTRODUCTORY.

SINCE the departure of Colonel D. Bruce, F.R.S., for England on August 28, 1903, the work of the Commission was carried on by Greig and Nabarro until November 20, 1903. On that date Dr. Nabarro left Entebbe for England. The work of the Commission was conducted by Captain Greig until he was joined on March 9, 1904, by Lieutenant A. C. H. Gray, R.A.M.C.

Captain Greig left Entebbe for England on November 15, *viâ* the Nile and Egypt.

This Continuation Report brings the work of the Commission up to the date of Greig's departure for England.

In this Report evidence is brought forward which affords additional proof of the correctness of the conclusions arrived at in the last Report. Further evidence is brought forward to show:—

1. That the disease is at first a specific polyadenitis caused by the Trypanosoma gambiense.
2. That in addition to enlargement of lymphatic glands the blood shows a constant lymphocytosis at all stages of the disease.
3. That Sleeping Sickness is the last stage of this disease, and is invariably fatal. It consists essentially in a polyadenitis plus signs and symptoms due to changes in the nervous system; the onset of these signs and symptoms synchronises with the entrance of the Trypanosoma gambiense into the lymph spaces of the nervous system; this is accompanied by a rise of the mononuclear elements in the cerebro-spinal fluid.
4. That the resistance of both men and monkeys to the Trypanosoma gambiense, as judged by the duration of the early stage, varies greatly, and probably a certain proportion, not yet exactly determined, acquire sufficient immunity to arrest the development of the disease at that stage.
5. That the action of arsenic in vita on the Trypanosoma gambiense is partial. It destroys a number of the trypanosomes, and probably these act as immunising agents. Its administration in the stage of polyadenitis tends to help the natural resistance to combat the disease.
6. That bacterial invasion, chiefly coccal, occurs in some cases, but only in the very last days of the sleeping sickness stage, and therefore cannot determine the onset of this phase of the malady.

7. That in addition to the Trypanosoma gambiense, other varieties of trypanosoma occur in Uganda which are pathogenic to animals.
8. That these trypanosomes differ entirely from Trypanosoma gambiense in morphology and animal reactions.
9. That one of these trypanosomes is probably identical with *Trypanosoma brucei*. The other two differ from it and are, provisionally, unclassed.
10. That these varieties of trypanosomes are conveyed from the sick to the healthy by the Uganda tsetse fly (*Glossina palpalis*) and not by other biting flies (Stomoxys).

The general situation as regards sleeping sickness in Uganda at the present time may be summed up as follows:— In the sleeping sickness areas from 50 per cent. to 75 per cent. of the inhabitants are in the stage of polyadenitis and are carrying on their ordinary work, because the disease at this stage produces few symptoms; but they are acting as reservoirs of the parasite, like the wild animals in the case of Nagana. It is this class of case that is specially liable to infect "clean" fly belts. The after history of these early cases, so far as we have observed up to the present, is as follows:— (1) That they may terminate fatally, either (*a*) by passing into the stage of sleeping sickness, which is the most frequent and usual; (*b*) through some intercurrent affections, particularly pneumonia. In this connection it is interesting to note that Dr. Albert Cook has observed that the admissions for pneumonia to the C.M.S. Hospital, Mengo, have risen markedly within the last two years. (2) That they remain in good health for long periods, indicating that at least a "tolerance" to the parasite has been acquired. The question then arises: will any of these individuals acquire sufficient immunity to destroy the parasite at this stage? Can they in fact become "salted"? and further, can this immunity by any means be artificially increased?

From reports just received there is reason to believe that the hitherto "clean" fly belt on Lake Albert and the Nile has become infected. The suspected district is Bugungu near Fajao, where the *Glossina palpalis* was obtained last year. The subject is being further investigated. If the disease is sleeping sickness, the infection must have been either carried across Unyoro from Uganda or travelled along the Nile from Usoga. As the *Glossina palpalis* has been found at Nimule and probably exists north of that, the disease will involve an extensive tract of fresh country.*

* The most recent Reports confirm the original information that sleeping sickness has broken out in this area. Captain Greig is proceeding to England, *viâ* the Nile and Egypt, in order to investigate this outbreak and also to determine the presence or absence of *Glossina palpalis* and trypanosomiasis in Egypt. The results of this expedition will be reported on its completion, *vide* Report 12 (p. 273).

A feature in the morbid anatomy of sleeping sickness, to which attention has not previously been directed, is a curious condition found in the stomach. In a number of cases the organ was found to contain a quantity of dark, semi-fluid material. The mucous membrane showed a remarkable alteration; it was studded with areas of varying size, having a dark centre and a light red periphery. They were most numerous towards the pyloric orifice, *vide* Plate 7, p. 266. On microscopical examination they were seen to be petechial hæmorrhages into the mucous membrane, which had broken down and formed superficial ulcers. No ova of Bilharzia were seen in the scrapings. A full account is given in the histories of the cases recorded in the Appendix. In all cases in which the stomach was inspected this condition was met with. The condition is comparable with the petechial hæmorrhages met with under the endo- and epicardium of the heart in trypanosoma infections.

The members of the Commission take this opportunity of expressing their most sincere thanks to Colonel Hayes-Sadler, C.B., His Majesty's Commissioner and Consul-General, Uganda, for his constant kindness and encouragement; to Mr. George Wilson, C.B., His Majesty's Acting Commissioner, Uganda, for helping forward the work of the Commission; to Mr. W. Grant, C.M.G., for his co-operation in the work in Busoga; to Major Will, P.M.O., for facilities afforded; to Dr. Moffat, C.M.G., for his valuable help and advice; to the Bishops of the various churches and their missionaries. We desire to express our best thanks to Professor Ray Lankester, the Director, to Mr. Austen, the entomologist, and Mr. Jeffrey Bell, of the British Museum (Natural History), for their kindness in examining and reporting on specimens sent; lastly, to Mrs. Bruce for several very accurate coloured drawings, and to Colonel Bruce, F.R S., whose co-operation in England has been of the greatest value to us here.

1. *The lymphatic glands of every case of sleeping sickness are enlarged and the juice taken by puncture during life contains many active trypanosomes and also disintegrating forms.*

Every case of sleeping sickness here has shown enlargement of the lymphatic glands. The enlargement of the femoral, inguinal, axillary and superficial cervical glands can, during life, be readily determined, and after death the abdominal, thoracic and deep cervical.

In the *Proceedings of the Royal Society* for May, 1904, it was pointed out that the juice of the lymphatic glands, especially the posterior cervical glands, contains many active trypanosomes in all cases and at all stages of sleeping sickness.

Some of the juice can easily be obtained by puncturing a superficial gland in the posterior triangle of the neck with a hypodermic needle and sucking it into the needle by means of a syringe. The drop is then blown out on to a slide, covered with a cover glass and examined under a low power, 150 to

200 diameters of the microscope—Zeiss 16 mm. objective and Nos. 12 or 18 eyepiece. The trypanosomes are numerous in the juice and are readily found after a short search. In stained preparations, in addition to well-formed trypanosomes, there exist a considerable number of disintegrating forms, suggesting that destruction of trypanosomes takes place in the glands. Similar preparations from a drop of peripheral blood were prepared and examined at the same time, but a prolonged search in the majority of cases failed to discover the presence of trypanosomes.

A practical outcome of these observations will be, that the recognition of sleeping sickness in its earliest stages will be a matter of easy accomplishment: the enlargement of the superficial lymphatic glands presents a sign which will arrest the attention of the observer, and the determination, by the above method, of the presence of trypanosomes in them can be very simply carried out.

The trypanosomes are present in small numbers in the peripheral blood, but from time to time an increase in their numbers takes place. This increase suggests that an occasional overflow from the glands, to which they are chiefly confined, takes place. The trypanosomes are sometimes more numerous in the blood taken at night time.

The juice of the gland was found sterile and free from streptococci even at a late stage of the disease. As will be shown later, the streptococcic invasion occurs only when the patient is moribund.

A point of interest, in connection with glandular enlargements due to Trypanosoma gambiense, is that in monkeys which have been inoculated with the trypanosoma, glandular enlargement is not so marked as in man, the parasite being found more frequently in the blood of monkeys, the disease being in monkeys more a blood one than is the case in man. This absence of gland enlargement in monkeys might explain why the mononuclear exudation which is present in all cases of sleeping sickness (Mott) is not also seen in monkeys.

The following table shows the result of these enumerations at all stages of the disease in cases of sleeping sickness:—

RESULT OF THIS PROCEDURE IN 62 CASES.

Date. 1904.	No.	Name.	Age.	Sex.	Stage of disease.	Situation of glands.	Parasites in lymph juice.		Parasites in peripheral blood.		
							Strepto.	Tryp.	Filar.	Malar.	Tryp.
March 14	1	Sempagama	10	M.	2nd	R. post. triangle ...	Absent	Present	Present	Absent	Absent
„ 15	2	Sabakaki	12	„	2nd	R. post. triangle ...	„	„	„	„	„
„ 16	3	Naguta	25	F.	1st	L. ant. triangle ...	„	„	Absent	„	„
„ 17	4	Zeridan	10	M.	3rd	L. post. triangle ...	„	„	„	„	„
						L. femoral ...	...	„	...	...	...
„ 19	5	Abimerika	25	„	2nd	R. post. triangle ...	Absent	„	Absent	Absent	Absent
						L. femoral ...	...	„	...	...	...
„ 21	6	Jordan Murjan ...	35	„	1st	L. ant. triangle ...	Absent	„	Absent	Absent	Absent
						R. femoral ...	...	„	...	...	...
„ 22	7	Zrigoa	20	„	3rd	R. post. triangle ...	Absent	„	Present	Absent	Absent
						R. femoral ...	...	Absent	...	...	...
„ 23	8	Erya	25	„	1st	L. post. triangle ...	Absent	Present	Present	Absent	Absent
						R. femoral ...	...	Absent	...	...	...
„ 26	9	Wasiwa	18	„	2nd	L. post. triangle ...	Absent	Present	Present	Absent	Absent
						R. femoral ...	...	„	...	...	...
„ 27	10	Nasanera	25	„	3rd	L. post. triangle ...	Absent	„	Present	Absent	Absent
						L. femoral ...	...	„	...	...	...
„ 28	11	Kirongo	35	„	2nd	L. post. triangle ...	Absent	„	Absent	Absent	Absent
						R. femoral ...	...	„	...	...	...
„ 29	12	Tabula	26	„	Early stage	R. post. triangle ...	Absent	„	Absent	Absent	Absent
„ 30	13	Bara Risgalla ...	36	„	„	R. ant. triangle ...	„	„	„	„	„
						L. femoral ...	...	Absent	...	...	...

RESULT OF THIS PROCEDURE IN 62 CASES—*continued.*

Date 1904.	No.	Name.	Age.	Sex.	Stage of disease.	Situation of glands.	Parasites in lymph juice.		Parasites in peripheral blood.		
							Strepto.	Tryp.	Filar.	Malar.	Tryp.
April 4	14	Karala Barigi ...	25	M.	Early stage	R. post. triangle ...	Absent	Present	Absent	Absent	Absent
„ 5	15	Kumsasabba ...	26	„	„	L. post. triangle ...	„	„	„	„	„
„ 9	16	Zmiwanguiza ...	20	„	3rd	L. post. triangle ...	„	„	„	„	„
„ 11	17	Yerimya	30	„	2nd	L. post. triangle ...	„	„	Present	„	„
„ 13	18	Danielli	20	„	1st	L. post. triangle ...	„	„	Absent	„	„
„ 13	19	Gangabudi	35	„	3rd	R. ant. triangle ...	„	„	„	„	„
„ 13	20	Numa	25	„	1st	L. post. triangle ...	„	„	„	„	„
„ 25	21	Sumani	18	„	3rd	R. ant. triangle ...	„	„	„	„	„
„ 28	22	Musaja Kangoa ...	35	„	2nd	R. and L. post. triangles	„	„	Present	„	„
May 2	23	Daudi Makasa ...	18	„	1st	R. and L. post. triangles	„	„	„	„	„
„ 3	24	Arena	16	F.	„	R. and L. post. triangles	„	„	Absent		„
„ 4	25	Kaboa Jongira ...	14	M.	„	R. post. triangle ...	„	„	„	„	„
„ 5	26	Hamisi	14	„	„	L. post. triangle ...	„	„	Present	Present	Present
„ 6	27	Msoge	16	„	„	R. post. triangle ...	„	„	Absent	Absent	Absent
„ 10	28	Arisati	7	F.	„	R. and L. post. triangles	„	„		„	„
„ 11	29	Mondu	38	M.	2nd	R. ant. triangle ...	„	„	„	„	„
„ 14	30	Juma...	35	„	1st	R. ant. triangle ...	„	„	„	„	„
„ 17	31	Arcada	25	„	2nd	R. ant. triangle ...	„	„	„	„	Present

„	18	32	Simoni	20	„	2nd	R. post. triangle ...	„	„	„	„	Absent
„	19	33	Yosuwa Bazambude	20	„	1st	L. post. triangle ...	„	„	„	„	„
„	20	34	Nuwa Kakabange ...	31	„	2nd	L. post. triangle ...	„	„	„	„	Present
„	21	35	Lotone	40	„	3rd	R. femoral ...	„	„	„	„	Absent
„	23	36	Zakayo	15	„	2nd	R. post. triangle ...	„	„	„	Present	„
„	25	37	Asumani	14	„	3rd	L. post. triangle ...	„	„	„	Absent	„
„	26	38	Abrahim	18	„	2nd	R. ant. triangle ...	„	„	„	„	„
„	27	39	Labaka	20	F.	1st	L. post. triangle ...	„	„	„	„	„
„	29	40	Zaka	25	M.	Early stage	R. post. triangle ...	„	„	„	„	Present
„	29	41	Dona	25	„	„	L. post. triangle ...	„	„	„	Present	Absent
June	1	42	Wabasa Abamullah	35	F.	3rd	L. post. triangle ...	„	„	„	Absent	„
„	3	43	Bafirawalla	18	M.	„	L. post. triangle ...	„	„	„	„	„
„	6	44	Tenwa	25	„	Early stage	L. post. triangle ...	„	„	„	„	Present
„	6	45	Kitsame	26	„	„	L. post. triangle ...	„	„	„	„	„
„	12	46	Manawa	25	„	„	L. post. triangle ...	„	„	„	„	„
July	6	47	Nkola	25	„	„	L. post. triangle ...	,	„	„	„	Absent
	6	48	Suedi...	30	„	2nd	R. post. triangle ...	„	„	„	„	„
„	9	49	Mondu	25	„	Early stage	R. post. triangle ...	„	„	Present	„	Present
„	11	50	Zimageza	14	„	2nd	L. post. triangle ...	„	„	Absent	„	„
„	13	51	Nematude	20	F.	Early stage	L. post. triangle ...	„	„	„	„	„
August	10	52	Kasemota	25	M.	„	R. post. triangle ...	„	„	„	„	Absent
„	15	53	Alyabu Mustaffa ...	25	„	2nd	R. post. triangle ...	„	„	„	„	Present
„	17	54	Sururu Mzee ...	25	„	3rd	L. post. triangle ...	Present	„	„	„	Absent
„	24	55	Asha	16	F.	„	R. post. triangle ...	Absent	„	„	„	„
Sept.	20	56	Redza	14	M.	Early stage	L. post. triangle ...	„	„	Not observed	Not observed	Not observed
„	24	57	Omera	14	„	„	L. post. triangle ...	„	„	Absent	Absent	Absent
„	26	58	Matiansi	22	„	1st	L. post. triangle ...	„	„	Not observed	Not observed	Not observed
„	27	59	Sabugao	22	„	„	L. post. triangle ...	„	„	Absent	Absent	Absent
Oct.	13	60	Marco Lukoma ...	35	„	Early stage	R. post. triangle ...	„	„	Not observed	Not observed	Not observed
„	19	61	Mabruki	30	„	2nd	L. post. triangle ...	„	„	„	„	„
„	26	62	Petro	25	„	1st	L. post. triangle ...	...	„	„	„	

2. *The lymphatic glands of cases of so-called "Trypanosoma Fever" are enlarged and the juice taken by puncture during life contains active and disintegrating trypanosomes.*

The early cases of trypanosomiasis examined here have all presented enlargement of the lymphatic glands and on puncturing them, active trypanosomes have been readily found. At this stage of the disease the condition is essentially a polyadenitis.

Sleeping sickness is this specific polyadenitis with signs, originating in a derangement of the nervous system due to changes produced by the presence of the parasites there, superadded.

The occurrence of enlargement of the lymphatic glands with the presence of trypanosomes in number in both early cases of trypanosomiasis and sleeping sickness affords additional evidence in favour of the unity of the two conditions.

The natives themselves are alive to the fact that, when the glands in the neck become enlarged, they will, sooner or later, pass into the stage of sleeping sickness, and their custom is, then, to eat up their live stock, goats, chickens, &c.

In the above table the results of the examination of these early cases are given.

From the above observations the next question arises—

3. *What is the incidence of enlargement of lymphatic glands amongst the general population?*

It seemed important to test the above observations on a large scale. If trypanosomiasis causes adenitis, cases of enlargement of glands should be more numerous in the sleeping sickness areas than in the non-sleeping sickness areas. The incidence of gland enlargement in the sleeping sickness areas would be a gauge of the incidence of trypanosomes in the general population in sleeping sickness areas, because the majority of cases coming from sleeping sickness areas with enlarged glands have on examination showed the presence of trypanosomes in the glands.

In the sleeping sickness areas the incidence was obtained by the help of the Rev. H. T. C. Weatherhead, B.A., in the islands of Sese and Kome.

The results of these enumerations are given in the following lists. These have been given in full, and as each individual in these sleeping sickness areas has been accurately located, they will be of importance in following out the after history of the patients:—

Incidence of Gland Enlargement of General Population.

A. Sleeping Sickness Area—Sese Islands.

Date. 1904.	Name.	Age.	Sex.	District.	Shamba.	Name of Chief.	Glands of Neck.
May 27	Yeremiya Mutanulwa ...	30	M.	Bukasa	Embuga	Kaganda	−
„	Labahi Bugutana	25	„	„	„	„	+
„	Zamala...	20	„	„	„	„	−
„	Lukusa...	55	„	„	Buzingo	„	−
„	Lwemba	40	„	„	Embuga	„	+
„	Baswezi	50	„	„	Buzingo	„	−
„	Sabakaki	16	„	Mengo (Buganda) ...	Lubaga	Sezi	+
„	Petero Kukulubwa	40	„	Bukasa	Embuga	Kaganda	−
„	Wasuzi...	30	„	„	„	„	+
„	Daki	13	„	„	„	„	+
„	Mukasa	15	„	Bubeke	Bulega	Katonya	−
„	Mukwaya	14	„	„	„	„	−
„	Simeoni Nsiyaleta	22	„	Bukasa	Embuga	Kaganda	−
„	Tomasi Bajira...	28	„	„	„	„	−
„	Sitefans Tefe	16	„	„	„	„	+
„	Tito Zirimeniya	12	„	„	„	„	−
„	Kivamengo	11	„	„	„	„	+
„	Myangubi	11	„	„	„	„	+
„	Kabanda	11	„	„	„	„	−
„	Tazerika	13	„	„	„	„	−
„	Eriga Bagalisa	20	„	„	„	„	+
„	Kakwenda	35	„	„	„	„	−

INCIDENCE OF GLAND ENLARGEMENT OF GENERAL POPULATION—*continued.*

Date. 1904.	Name.	Age.	Sex.	District.	Shamba.	Name of Chief	Glands of Neck.
May 27	Kagwagwa	55	M.	Bukasa	Embuga	Kaganda	–
„	Sebugawo	45	„	„	Buwazi	„	+
„	Luvokwaya	48	„	„	„	„	+
June 2	Mika Mbujeramba	20	„	Bugela	Kibanga	Church	–
„	Takiko Kitonze	25	„	„	„	„	–
„	Zakayo Mulwaniji	28	„	Kome	Buve	„	+
„	Kezekiya Muganda	28	„	Bukasa	Mpata	Kaganda	-
„	Abiri Mukubansi	30	„	„	Embuga	„	-
„	Enoka Kubolikoza	23	„	Bugala	Kibanga	Church	+
„	Lebeka...	30	F.	Bagale	Kibanza	Lukanga	+
„	Daudi Kabimula	30	M.	„	„	Church	+
„	Zekaligo Bakiku	32	„	„	„	„	+
„	Ibalaimu Alideki	30	„	Bufumira	Church	„	+
„	Gakobo Malikau	30	„	Bubeke	„	Katonya	–
„	Siva Semusawbwa	40	„	Bukasa	Buwanga	Kaganda	+
„	Nawa Musalala	28	„	Bugala	Church	Church	+
June 4	Kezekiya Yetokira	30	„	Buninga	Kasayi	Sewoya	–
„	Zamala...	30	„	Lujabwa	Lujabwa	Semukade	+
„	Isaka Kawabwe	40	„	Bugala	Bugala	Kweba	–
„	Meseka Kibira	40	„	Busi	Bumisa	Mugema	–
„	Nsika	20	„	Bubembe	Bubembe	Gugu...	+
„	Nekemya Kalabau Jake ...	25	„	Bulima	Bwendero	Serninaga	+
„	Basibye	40	„	Bafumira	Bafumira	Namuimba	-
„	Namabiga	55	„	Buvu...	Buwanga	Kamu Musaka ...	+

,,	Ganawula	40	,,	Bubeke	Kande	Sabagabo	−
,,	Sempagama	35	,,	Buninga	Bugoye	Sewoya	+
,,	Eria Byasi	30	,,	Bugala	Church	Church	−
,,	Mbageramula	25	,,	Bugale	,, ...	,, ...	+
,,	Weraga	25	,,	,, ...	,, ...	,, ...	+
,,	Semu Tagurisiza	25	,,	,, ...	,, ...	,, ...	+
,,	Mbugeramula	25	,,	,, ...	,, ...	,, ...	−
,,	Petero Balimuta	25	,,	,, ...	,, ...	,, ...	−
,,	Erasito Weraga	23	,,	,, ...	,, ...	,, ...	−
,,	Yoweri Sebagoti	30	,,	,, ...	,, ...	,, ...	−
,,	Kapelaga	23	,,	,, ...	,, ...	,, ...	−
,,	Mirika wa Muzungu	35	F.	,, ...	,, ...	,, ...	−
,,	Ketula ,, ...	17	,,	,, ...	,, ...	,, ...	+
,,	Ana ,, ...	19	,,	,, ...	,, ...	,, ...	−
,,	Foesi ,, ...	14	,,	,, ...	,, ...	,, ...	−
,,	Eunike ,, ...	15	,,	,, ...	,, ...	,, ...	+
,,	Kala ,, ...	11	,,	,, ...	,, ...	,, ...	−
,,	Amaziya ,, ...	15	,,	,, ...	,, ...	,, ...	+

A. Sleeping Sickness Area—Kome Island.

June 25	Aloni Mukasa...	26	M.	Kome	Buwe...	Church	−
,,	Ibulaimu Kigwana	35	,,	,, ...	Busaka	Malaki	−
,,	Kamu Wallabye	35	,,	,, ...	Mubembe	Timoteo Sabadago ...	−
,,	Yona Kidolime	25	,,	,, ...	Buwe...	Church	−
,,	Zakaliya Bazironda	30	,,	,, ...	Ngaga	Kiranze	+
,,	Leubeni Wakalo	30	,,	,, ...	Buwe...	Church	−
,,	Muvawala	28	,,	,, ...	Busanga	Sekoba	+
,,	Tebampirawabwe	25	F.	,, ...	Buwe...	Church	−
,,	Eduwadi Kiribwa	25	M.	,, ...	,, ...	,, ...	+

INCIDENCE OF GLAND ENLARGEMENT OF GENERAL POPULATION—*continued.*

Date. 1904.	Name.	Age.	Sex.	District.	Shamba.	Name of Chief.	Glands of Neck.
June 25	Zakaliya Luanga	25	M.	Kome	Bajo	Zakalia Nanganga ...	–
,,	Yonasani Batirya	25	,,	Nsazi...	Tabaliro	Serinya	–
,,	Kipanda	40	,,	Kome	Sama...	Mwambi	+
,,	Bakayana	45	,,	,, ...	,, ...	,, ...	+
,,	Eriya Kwabo	30	,,	,, ...	,, ...	,, ...	–
,,	Kalibwani	55	,,	,, ...	Mubembe	Sabadago	+
,,	Kiranze	35	,,	,, ...	Ngaga	Kiranze (himself) ...	–
,,	Nantagya	55	,,	,, ...	Sama...	Mwambi	+
,,	Kiwuja...	16	,,	,, ...	,, ...	,, ...	+
,,	Malakufana	23	,,	,, ...	,, ...	,, ...	+
,,	Muluku	30	,,	,, ...	Mubembe	Sabadago	–
,,	Zirigwa	30	,,	,, ...	Kabangala	Kipanda	+
,,	Wakigo	30	,,	,, ...	Basanga	Sekoba	+
,,	Mukubampanga	35	,,	,, ...	Kabangala	Kipanda	+
,,	Mutekanga	30	,,	,, ...	Sama...	Mwambi	+
,,	Kwatabaliawo...	20	,,	,, ...	Bugombe	Mukusu	–
,,	Kapere...	20	,,	,, ...	,, ...	,, ...	+
,,	Bazitye...	20	,,	,, ...	Kituza	Walagana	–
,,	Banaleka	35	,,	,, ...	Kabembe	(Himself)	+
,,	Katuntu	35	,,	,, ...	Sama...	Mwambi	–
,,	Swabidere	40	,,	Swaji...	Sese	Sekulu	–
,,	Kibadu...	30	,,	Kome	Busaka	Malaki	–
,,	Wakigeri	30	,,	,, ...	Sama...	Mwambi	–
,,	Sabakaki	15	,,	,, ...	,, ...	,, ...	+

„	Logwabwi	17	„	„	...	...	Mubembe	...	...	Sabadago	...	...	+
„	Kadali	50	„	„	...	...	„	...	...	„	...	...	+
„	Waswa...	10	„	„	...	...	Sama...	...	...	Mwambi	...	...	−
„	Nasaza	20	F.	„	...	...	Busaka	...	...	Malaki	...	...	−
„	Lwankodabuli...	18	„	„	...	...	Ngoge	...	...	Sabadu	...	...	−
„	Madalina	30	„	„	...	...	Bugombe	...	...	Mukusu	...	...	−
„	Sabadu...	50	M.	Lwaje	...	...	Tembo	...	...	Sekulu	...	...	−
„	Sabakaki	16	„	Kome	...	...	Sama...	...	...	Mwambi	...	...	+
„	Kapelaga	15	„	„	...	...	„	...	...	„	...	...	+
„	Mwangwa	15	„	„	...	...	„	...	...	„	...	...	+
„	Mpalikitenda	35	„	„	...	...	„	...	...	„	...	...	+
„	Nuwa Lugwanax	30	„	„	...	...	Bugungo	...	...	Matayo	...	...	−
„	Tusinzomu	30	F.	„	...	...	Bugombe	...	...	Mukusu	...	...	+
„	Mujasi	40	M.	„	...	...	Sama...	...	...	Mwambi	...	...	−
„	Tewagwa	40	„	„	...	...	„	...	...	„	...	...	+
„	Balagana	45	„	„	...	...	Kituza	...	...	(Himself)	...	...	−
„	Nakumanyanja	50	„	„	...	...	Sama...	...	...	Mwambi	...	...	+
„	Damala...	30	F.	„	...	...	„	...	...	„	...	...	−
,	Gwodiriza	50	„	„	...	...	Kabembe	...	...	Banaleka	...	...	−
„	Twalaba	30	„	„	...	...	Sama...	...	...	Mwambi	...	...	+
,	Siruganzizibwa	20	„	„	...	...	Mubembe	...	...	Sabadago	...	...	+
„	Tabalamule	55	M	„	...	...	Ngogo	...	...	Sabadu	...	...	−
„	Gavamukubya	20	F.	„	...	...	Sama...	...	...	Mwambi	...	...	+
„	Balyagala	18	„	„	...	...	„	...	...	„	...	...	+
„	Lwanguja	30	„	„	...	...	„	...	...	„	...	...	−
„	Kosiya Kawunui	25	M.	„	...	...	„	...	...	„	...	...	−
„	Tusokuwebwa...	22	F.	„	...	...	Kitwalira	...	...	Aliwebwa	...	...	+
„	Tuitana	40	„	„	...	...	Sama...	...	...	Mwambi	...	...	+
„	Alirwa	25	„	„	...	...	Neseka	...	...	Semagonge	...	...	−
„	Tusabe	30	„	„	...	...	Sama...	...	...	Mwambi	...	...	−
„	Bulirwe	18	M.	„	...	...	Ngaga	...	...	Kiranze	...	...	+

Examination of population of "B. Non-Sleeping Sickness Areas," showed that the incidence of gland enlargement was low.

4. *Lymphocytosis occurs in all cases of sleeping sickness.*

Enlargement of lymphatic glands being a constant feature in sleeping sickness, it was a matter of importance to determine whether the lymphocytes in the blood show an increase in numbers. This point is of interest further, because the most constant lesion found in the nervous system of sleeping sickness cases is an accumulation of cells of this nature in the perivascular lymph spaces.

In uncomplicated cases of sleeping sickness anæmia does not occur, the number of the red cells and the percentage of hæmoglobin being normal. Towards the end, in a certain proportion of cases, the number of red cells, the percentage of hæmoglobin and the specific gravity rise above the normal. These cases did not present any signs of cyanosis. The examination of the bone marrow in one of these cases showed a very large number of nucleated red cells, chiefly normo-blastic, but some megalo-blasts were also present.

Mast cells were present in the blood of all cases to the extent of about 1 per cent.

The eosinophiles, also, form a higher proportion of the leucocytes than is normally met with.

The examination of the blood was made by means of a Thoma-Zeiss blood counting apparatus and a Gowers' hæmoglobinometer.

It was also found that the trypanosomes were more numerous in the blood at night time.

The following table shows the result of the enumeration of the blood cells and the percentage of hæmoglobin in 57 cases of sleeping sickness:—

Results of Enumeration of Blood Corpuscles in above Cases.

Date. 1904.	No.	Name.	Age.	Sex.	Stage of disease.	R.B.C's.	W.B.C's.	Percentages.				Hb. Per cent.
								P.N.	S.M.	L.M.	E.	
March 16	1	Sempagama	10	M.	2nd	...	...	53	33	14	...	...
June 2	„	„	„	„	3rd	4,340,000	8,750	26	52	22	0	72
„ 5	„	„	„	„	...	4,400,000	10,000	33	45	19	3	72
„ 15	„	„	„	„	...	3,600,000	74,680	42	43	15	0	70
March 16	2	Sabakaki	12	M.	2nd	...	...	32	37	31	...	...
June 5	„	„	„	„	3rd	3,900,000	6,800	57	34	9	...	68
March 16	3	Naguta	25	F.	1st	...	7,500	54	28	18	0	...
„ 17	4	Zeridan	10	M.	3rd	...	15,000	45	39	14	2	...
„ 18	5	Abimerika	25	M.	2nd	...	8,600	50	27	13	10	...
April 11	„	„	„	„	...	5,200,000	15,000	22	58	6	14	...
„ 21	„	„	„	„	...	5,300,000	13,900	29	48	15	13	84
May 10	„	„	„	„	...	5,000,000	13,700	24	25	43	8	90
„ 31	„	„	„	„	...	5,000,000	9,370	35	21	28	16	80
June 4	„	„	„	„	...	5,300,000	10,000	32	27	38	3	90
March 21	6	Jordan Murjan	35	M.	1st	...	6,560	52	30	13	5	...
June 7	„	„ „	„	„	...	4,000,000	9,400	52	27	17	4	...
March 22	7	Zrigoa	20	M.	3rd	...	9,060	53	37	10	0	...

RESULTS OF ENUMERATION OF BLOOD CORPUSCLES IN ABOVE CASES—*continued.*

Date. 1904.	No.	Name.	Age.	Sex.	Stage of disease.	R.B.C's.	W.B.C's.	Percentages.				Hb. Per cent.
								P.N.	S.M.	L.M.	E.	
March 23	8	Erya	25	M.	1st	...	10,900	46	34	18	2	...
„ 27	9	Wasiwa	18	M.	2nd	...	13,400	49	29	8	14	...
April 19	„	„	„	„	...	5,300,000	11,200	33	49	9	10	...
June 8	„	„	„	„	...	5,500,000	10,300	40	15	8	0	94
„ 30	„	„	„	„	...	5,500,000	11,200	48	44	4	4	92
July 15	„	„	„	„	3rd	5,700,000	7,800	52	31	16	1	95
March 28	10	Nasanenni	25	M.	3rd	...	16,500	38	48	12	2	...
„ 28	11	Kirongo	35	M.	2nd	...	6,400	51	35	10	4	...
April 11	„	„	„	„	„	5,200,000	7,800	42	49	5	4	...
„ 25	„	„	„	„	„	4,900,000	17,800	25	50	17	8	82
June 14	„	„	„	„	„	4,400,000	16,200	30	41	15	14	80
March 28	12	Tabula	26	M.	Early stage	...	6,800	37	38	25	1	...
June 4	„	„	„	„	„	4,200,000	9,300	40	40	17	3	80
„ 27	„	„	„	„	„	4,400,000	18,700	...	...	...	...	68
March 30	13	Bara Risgallah	36	M.	Early stage	...	6,870	59	29	11	1	...
April 27	„	„ „	„	„	„	4,500,000	6,200	69	23	8	0	...
„ 4	14	Karala Barigi	25	M.	Early stage	...	22,500	53	32	10	5	...

„ 5	15	Kumsarsabba	26	M.	Early stage	...	10,900	48	42	9	1	...
„ 9	16	Zimwanguyza	20	M.	3rd	...	9,300	50	40	9	0	...
„ 20	„	„	„	„	„	4,200,000	8,000	57	31	12	0	65
„ 11	17	Yerimya	30	M.	2nd	4,500,000	7,800	42	49	5	4	...
„ 19	„	„	„	„	„	5,500,000	11,200	33	49	9	10	...
„ 28	„	„	„	„	„	5,300,000	9,060	35	47	16	2	85
„ 13	18	Danielli	20	M.	1st			No observations.				
„ 13	19	Gangabuda	35	M.	3rd			„	„			
„ 13	20	Johanna Numa	25	M.	1st			„	„			
„ 25	21	Sumani	18	M.	3rd	4,400,000	10,300	23	44	23	10	78
May 9	„	„	„	„	„	4,600,000	7,500	45	25	16	14	75
April 28	22	Musaja Kangow	35	M.	2nd	4,500,000	14,000	30	38	30	2	80
„ 30	23	Daudi Mukasa	18	M.	1st	4,500,000	12,200	24	27	26	23	76
May 3	24	Arena	16	F.	1st	5,000,000	14,060	58	29	13	...	76
„ 4	25	Kaba Jongira	14	M.	1st	5,000,000	14,300	30	33	19	18	90
„ 5	26	Hamisi	14	M.	2nd	3,800,000	13,700	52	27	16	5	64
„ 16	„	„	„	„	„	4,000,000	5,300	35	32	28	5	60
„ 19	„	„	„	„	„	...	8,740	31	37	22	10	...
June 16	„	„	„	„	„	5,200,000	13,000	50	34	11	5	78
„ 22	„	„	„	„	„	...	...	49	36	12	3	...
July 12	„	„	„	„	„	5,000,000	18,000	54	32	13	1	78

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RESULTS OF ENUMERATION OF BLOOD CORPUSCLES IN ABOVE CASES—*continued.*

Date. 1904.	No.	Name.	Age.	Sex.	Stage of disease.	R.B.C's	W.B.C's.	Percentages.				Hb. Per cent.
								P.N.	S.M.	L.M.	E.	
July 20	26	Hamisi	14	M.	3rd	5,400,000	38,100	65	24	11	...	84
May 6	27	Msoge	16	M.	1st	4,050,000	9,060	49	17	25	9	75
„ 10	28	Arisati	7	F.	1st	4,400,000	6,100	37	32	23	8	55
„ 10	29	Mondu	38	M.	2nd	5,000,000	9,500	23	41	25	10	80
„ 14	30	Juma	25	M.	1st	5,200,000	11,800	31	35	24	10	90
June 14	...	... ...	„	„	„	5,300,000	11,800	23	52	10	15	90
May 17	31	Arcadi	25	M.	2nd	5,100,000	17,000	35	34	29	2	84
July 14	„	„	„	„	3rd	5,900,000	13,750	54	30	9	...	100
„ 15	„	„	„	„	„	6,000,000	14,800	46	36	11	7	100
„ 19	„	„	„	„	„	6,000,000	12,500	55	33	9	3	102
„ 21	„	„	„	„	„	6,020,000	14,300	50	43	5	2	102
„ 18	32	Simeoni	20	M.	2nd	4,250,000	7,200	41	35	17	7	82
„ 19	33	Yosuwa Basambude ...	20	M.	1st	4,600,000	6,800	46	28	23	3	86
„ 20	34	Nuwa Kikabange ...	31	M.	2nd	4,750,000	16,000	29	38	30	3	66

„ 21	35	Lotone	40	M	3rd	2,600,000	6,800	60	23	14	3	35
„ 23	36	Zakayo	15	M.	2nd	3,800,000	20,300	30	40	18	12	70
„ 25	37	Asumani	14	M.	3rd	4,400,000	13,700	28	19	19	34	80
June 19	„	„	„	„	„	5,000,000	13,700	33	35	10	22	85
May 26	38	Abrahim	18	M.	2nd	4,000,000	22,200	28	51	17	6	82
„ 29	39	Labaka	20	F.	1st	...	...	41	32	18	9	...
June 18	„	„	„	„	„	5,300,000	9,700	39	46	7	8	90
May 29	40	Zaka	25	M.	Early stage	5,200,000	9,370	35	48	13	4	95
„ 29	41	Dona	25	M.	Early stage	4,500,000	13,700	30	38	24	8	82
June 1	42	Wabasa Abamullah ...	35	M.	3rd	4,350,000	10,900	62	16	11	11	70
„ 21	„	„ „	„	„	„	4,500,000	8,750	48	32	11	9	82
„ 3	43	Bafirawalla	18	M.	3rd	5,400,000	11,250	40	36	21	3	90
„ 20	„	„	„	„	„	5,000,000	8,000	36	51	11	2	74
„ 7	44	Tenwa	25	M.	Early stage	3,700,000	6,000	38	46	13	3	66
July 11	„	„	„	„	„	4,000,000	6,850	30	64	3	3	68
„ 17	„	„	„	„	„	4,300,000	6,600	14	69	9	8	74
June 7	45	Kitsame	26	M.	Early stage	4,800,000	12,500	47	30	21	2	80
July 8	„	„	„	„	„	4,200,000	3,800	25	61	2	12	72
„ 17	„	„	„	„	„	4,900,000	5,800	20	58	13	9	80
June 12	46	Manawa	25	M.	Early stage	4,650,000	13,120	33	28	30	9	6
July 10	„	„	„	„	„	4,800,000	11,870	33	41	18	8	78
„ 17	„	„	„	„	„	4,600,000	9,100	28	63	6	3	80

RESULTS OF ENUMERATION OF BLOOD CORPUSCLES IN ABOVE CASES—*continued.*

Date. 1904.	No.	Name.	Age.	Sex.	Stage of disease.	R.B.C's.	W.B.C's.	Percentages.				Hb. Per cent.
								P.N.	S.M.	L.M.	E.	
July 6	47	Nkolo	25	M.	Early stage	5,000,000	15,000	37	37	8	18	72
„ 6	48	Suedi	30	M.	2nd	4,000,000	7,500	41	44	8	7	70
„ 9	49	Mondu	25	M.	Early stage	5,200,000	8,700	47	38	5	10	80
„ 12	„	„	„	„	„	5,100,000	9,000	42	40	6	12	86
„ 17	„	„	„	„	„	5,130,000	10,000	32	48	8	12	89
„ 11	50	Zemageza	14	M.	2nd	5,000,000	10,900	52	28	18	2	88
„ 19	„	„	„	„	„	5,000,000	11,800	40	46	13	1	90
„ 13	51	Namutide	20	F.	Early stage	4,400,000	15,000	33	40	7	20	78
„ 15	„	„	„	„	„	4,500,000	10,000	26	49	9	16	76
Aug. 4	„	„	„	„	„	4,350,000	7,500	11	75	2	12	76
„ 10	52	Kazimota	25	M.	1st	5,100,000	8,120	51	31	15	4	86
Sept. 29	53	Aliabu	25	M.	1st	5,400,000	11,600	28	60	10	2	88
„ 18	54	Sururu	20	M.	3rd	4,900,000	3,800	60	22	12	6	66
„ 24	55	Omera	14	M.	Early stage	5,300,000	9,100	32	50	9	9	85
„ 27	56	Sebugao	20	M.	3rd	5,000,000	9,070	39	45	13	3	92
Oct. 19	„	„	„	„	„	5,200,000	7,500	29	60	7	4	94
„ 17	57	Kasussi	25	M.	Early stage	4,800,000	8,700	28	58	6	8	94

Following the suggestion of Mr. Plimmer, who found that the trypanosomes were more numerous in the blood of animals at night than in the daytime, some observations were made with the object of determining whether this was the case in men. It will be seen from the following table that some periodicity seems to exist in man also. The percentages which are taken as a rough index of the number of trypanosomes present, in a slide, refer to the number of trypanosomes per polynuclear leucocytes counted:—

Date 1904.	Name.	No.	Parasites in blood, daytime.			Parasites in blood, night time.		
			Filar.	Mal.	Tryp.	Filar.	Mal.	Tryp.
					per cent.			per cent.
June 21	Kitsame ...	303	...	...	+ 4	...	...	+ 8
„ 23	„ ...	„	...	...	+ 3	...	...	+ 10
„ 22	Arcadi ...	69/K.P.	...	...	+ 1	...	...	+ 1
„ „	Asumani ...	69/Z.D.	...	...	−	...	...	+
„ 23	Tenwa ...	302	...	...	−	...	...	+
„ 22	Juma ...	69/J.Q.	...	...	−	...	...	−
„ „	Hamesi ...	69/F.V.	...	...	+ 1	...	...	+ 2
„ „	Juma ...	69/J.Q.	...	...	−	...	...	−

5. *The cells of the cerebro-spinal fluid of sleeping sickness cases taken during life by lumbar puncture are lymphocytes and are more numerous in the late stages of the disease.*

Having seen that the lymphocytes of the blood are increased in number, the next step to take was to determine whether during life these elements were present in number in the cerebro-spinal fluid of sleeping sickness cases. The total number of cells per c.mm. of cerebro-spinal fluid was determined by means of a Thoma-Zeiss apparatus. Stained preparations were also made of the sediment obtained by centrifuging. The cells were found to be all lymphocytes.

From a study of the following table it will be seen that there is a progressive rise in the number of lymphocytes in the cerebro-spinal fluid as the disease advances, the following are the averages:—

23 per c.mm. ...	... Early Stage (Polyadenitis)
257 per c.mm. ...	... 1st Stage (S.S.)
355 per c.mm. ...	... 2nd Stage (S.S.)
730 per c.mm. ...	... 3rd (S.S.)

This result is of considerable interest when considered in connection with the post-mortem appearances found in the nervous system of sleeping sickness cases; these were shown by

Mott to consist essentially of an accumulation of mononuclear cells in the lymph spaces of the brain.

The following table shows the result of the estimation of the specific gravity of, the reaction of, the total and differential enumeration of the cells and the presence or absence of trypanosomes in, the cerebro-spinal fluid taken during life by lumbar puncture from cases of sleeping sickness at all stages of the disease :—

Date. 1904.	No.	Name.	Age.	Sex.	Stage of Disease.	Specific Gravity.	Reaction.	Total Cells. per c.mm.	Percentages.				Tryps. in C. S. F.
									P. N.	S. M.	L. M.	E.	
May 4	1	Kaboe Jongira ...	14	M.	1st	1,008	Alk.	400	...	...	...	...	Present.
„ 9	2	Sumani	18	„	2nd	1,008	„	300	2	75	23	...	„
„ 10	3	Arisati	7	F.	1st	1,007	„	300	1	77	22	...	„
„ 11	4	Mondu	38	M.	2nd	1,008	„	300	...	85	15	...	„
„ 14	5	Juma	25	„	1st	...	...	300	2	74	25	...	„
„ 17	6	Arkadi	25	„	2nd	1,008	...	1,090	2	78	20	...	„
„ 18	7	Simoni	20	„	2nd	1,008	...	156	·5	80	20	...	„
„ 20	8	Nuwa Kikabanga ...	31	„	2nd	...	...	680	·5	75	25	...	„
„ 20	9	Josuwa	20	„	Early	...	...	30	...	...	...	...	Absent.
„ 21	10	Lotone	40	„	3rd	...	...	78	...	85	15	...	Present.
„ 23	11	Zakayo	15	„	2nd	...	...	280	All mononuclears.				„
„ 25	12	Asmani	14	„	3rd	...	...	670	„				„
„ 26	13	Abrahim	18	„	3rd	...	...	2,340	„				„
„ 29	14	Zake	25	„	Early	...	...	16	„				Absent.
June 3	15	Bafirawala	18	„	2nd	...	...	578	„				Present.
„ 5	16	Sempagama	10	„	2nd	...	...	375	„				„
„ 6	17	Sabakaki	12	„	3rd	...	...	94	„				„
„ 7	18	Jordien Murjan ...	35	„	1st	...	...	30	„				„
„ 7	19	Tenwa	25	„	Early	...	...	16	„				Absent.
„ 7	20	Kitsami	26	„	„	...	...	30	„				„
„ 10	21	Msubika	17	F.	2nd	...	...	280	„				Present.
July 6	22	Suedi	35	M.	2nd	...	...	730	„				„
„ 15	23	Arcadi	25	„	3rd	...	...	970	„				„
Aug. 18	24	Zururu Mzee ...	25	„	3rd	...	...	219	„				„

6. *The gland juice in a certain proportion of cases in the last stage of the disease becomes infected by bacteria, especially diplo-streptococci.*

In view of the fact that some importance has been attached to streptococci as playing a part in the causation of sleeping sickness, a series of examinations of the gland juice were made in a number of cases at intervals in the course of the disease microscopically and culturally. The result of these observations showed, that a number remained cases of pure trypanosoma infection to the end, the cultures made from the glands, blood and cerebro-spinal fluid remained sterile. On the other hand in a proportion of cases an invasion, chiefly by diplo-streptococcus, did occur, but by the results of the examination at different stages of the disease it was possible to locate it to the final stage of the disease, when the patient was practically moribund.

These cases at this stage of the disease have invariably numerous foci of suppuration on the hands and feet due to jiggers, also there is frequently before death a purulent discharge from the gums: their vitality and resisting power is a negative quantity.

The results are fully recorded in the histories of the cases of sleeping sickness given in the Appendix. The following table shows the frequency of the occurrence of this bacterial invasion in sleeping sickness cases and the period of the disease at which it takes place:—

No.	Name.	Age.	Sex.	Date of Death. 1904.	Date of Examinations. 1904.	Diplo-streptococci in :—		
						Lymph glands.	Blood.	Cerebro-spinal Fluid.
1	Sabakaki	8	M.	June 18 ...	March 15 ...	Absent ...	...	...
					June 6 ...	„ ...	...	...
					„ 18 ...	„ ...	Absent ...	Absent.
2	Zeridan	16	„	March 24 ...	March 17 ...	„ ...	...	...
					„ 24 ...	Present ...	Present ...	Present.
3	Abimerika	22	„	June 11 ...	March 19 ...	Absent ...	...	...
					April 21 ...	„ ...	...	...
					June 4 ...	„ ...	...	...
					„ 11 ...	„ ...	Absent ...	Absent.
4	Wasiwa	18	„	July 22 ...	March 25 ...	„ ...	...	...
					June 30 ...	„ ...	...	...
					July 22 ...	„ ...	Absent ...	Absent.
5	Kirongo	40	„	June 16 ...	March 28 ...	„ ...	...	...
					June 12 ...	Present (Pneumococcus) ...	B. Coli Com. ...	Pneumococcus.
6	Zumageza	18	„	May 8 ...	April 9 ...	Absent ...	...	...
					„ 20 ...	„ ...	...	...
					May 8 ...	Present ...	...	...
7	Usmani	20	„	„ 19 ...	April 25 ...	Absent ...	...	...
					May 9 ...	„ ...	...	...
					„ 19 ...	„ ...	Absent ...	Absent.

No.	Name.	Age.	Sex.	Date of Death. 1904.	Date of Examinations. 1904.	Diplo-streptococci in :—		
						Lymph glands.	Blood.	Cerebro-spinal Fluid.
8	Msake	16	M.	May 24 ...	May 6 ...	Absent ...	...	...
					„ 24 ...	„ ...	Absent ...	Absent.
9	Hamisi	12	„	July 24 ...	May 5 ...	„ ...	...	...
					July 12 ...	„ ...	...	...
					„ 24 ...	Present ...	Present ...	Present.
10	Arcadi	25	„	July 27 ...	May 17 ...	Absent ...	...	...
					June 1 ...	„ ...	...	...
					July 14 ...	Present ...	...	...
					„ 19 ...	„ ...	...	...
					„ 21 ...	„ ...	...	...
					„ 27 ...	„ ...	Present ...	Present
11	Sempagama	8	„	June 15 ...	March 14 ...	Absent ...	...	...
					June 5 ...	„ ...	...	...
					„ 15 ...	„ ...	Absent ...	Absent.
12	Usmani	14	„	„ 26 ...	May 25 ...	„ ...	...	...
					June 19 ...	„ ...	...	...
					„ 25 ...	Present ...	...	...
					„ 26 ...	„ ...	Present ...	Present.

7. *Does the injection of a pure culture of diplo-streptococci obtained from sleeping sickness cases modify the course of the disease produced in monkeys by the Trypanosoma gambiense?*

Dr. Mott in a letter forwarded to the Commission suggested that it would be of interest to test the effect of injection of diplococci obtained from cases of sleeping sickness into monkeys suffering from trypanosoma infection. A pure culture in broth of a diplococcus obtained from the cerebro-spinal fluid of a case of sleeping sickness was used for the experiments. The injections were made subcutaneously and a large number of germs were introduced. The effects of the injection were observed in a healthy monkey, a monkey infected with Trypanosoma gambiense, which showed at the time of injection the parasite in the blood and only slight clinical manifestations, and finally a monkey infected with the same trypanosoma, but showing very well marked clinical signs. This injection did not produce any alteration of temperature or other morbid sign in the healthy animal, nor in the animal infected by the trypanosomes, but at an early stage of the disease; in the monkey which was seriously ill at the time of injection it produced a local suppuration. It is apparent from these observations that the streptococcus found in the tissues of sleeping sickness cases has very low pathogenic properties, and only gains a footing at all when the resisting power of the tissue is greatly diminished. It does not modify the course of the disease produced in monkeys by the Trypanosoma gambiense.

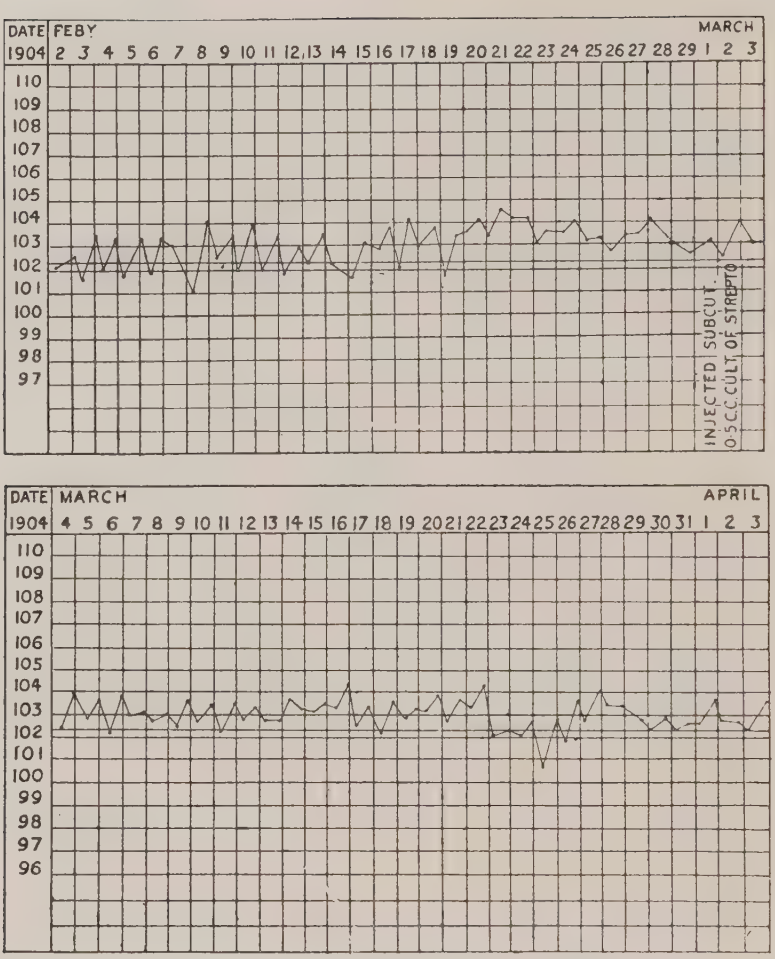
The following experiments show the effect on monkeys of the injection of a pure culture of diplo-streptococci from sleeping sickness cases:—

Experiment 285. Monkey, small (*Cercopithecus sp.*).

To note the effect of subcutaneous injection of a pure culture of diplo-streptococcus obtained from the cerebro-spinal fluid of a case of sleeping sickness.

March 2, 1904. Injected subcutaneously into left thigh 0·5 c.c. of a broth culture of diplo-streptococcus from the cerebro-spinal fluid (post-mortem) of case 69 K.K. The growth was 48 hours old. The growth was abundant. It was proved pure by microscopic examination and by sub-culture on agar. March 9. No local reaction at the seat of inoculation. The general health, temperature, etc., of the animal is normal.

The following chart shows the temperature curve before and for some time after the inoculation:—



. . . The temperature has since been regularly taken. It remains quite normal and the general condition of the animal is good.

Remarks.—This experiment shows that when a pure culture of the diplo-streptococcus is injected subcutaneously in considerable quantity into a healthy monkey it produces neither local nor general reaction. The pathogenic power must be low. It is incapable of producing any of the signs of sleeping sickness commonly met with in the infection produced by the Trypanosoma gambiense in monkeys.

Experiment 8. Monkey (*Cercopithecus sp.*).

To note the effect of subcutaneous injection of blood from case of trypanosoma fever into a monkey and secondly, the subcutaneous injection of a pure culture of streptococcus obtained from a case of sleeping sickness.

April 3, 1903. Injected subcutaneously a small quantity of blood from case J.M., whose blood is seen to contain trypanosomes this morning. The blood taken only amounted to a drop or so and had firmly clotted.

April 4. Injected about 1 c.c. of blood from same case.

May 11. Injected 2 c.c. of blood from Jordien Murjan.

August 25. No symptoms of sleeping sickness.

January 26, 1904. The animal has begun to look seedy. His expression is rather dull and his coat is not in good order.

March 28. Injected subcutaneously into right interscapular region 1·0 c.c. of a broth culture 72 hours old from Case 69 Q.Q. first remove. It was proved to be a pure culture of diplo-streptococcus by cultivation on agar and microscopic examination.

April 15. The general condition of the animal since the injection of the culture of streptococcus has remained unchanged.

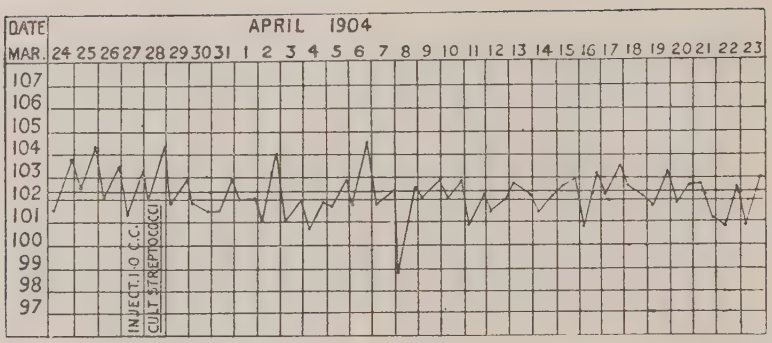
August 22. The animal is now distinctly ill. His coat is out of condition, and he is much thinner. He sits crouched up a good deal.

August 23. He has now a very dull drowsy expression and his head is constantly drooping between his knees.

August 27. He is now very weak and is lying on his side. The trypanosomes were very numerous in his blood; lumbar puncture was performed. The cerebro-spinal fluid contained some red cells. Active trypanosomes were present.

August 28. The animal is dying. Lumbar puncture performed; cerebro-spinal fluid clear. On microscopic examination active trypanosomes present and a few red cells.

The following chart shows the course of the disease after the injection of the streptococcus :—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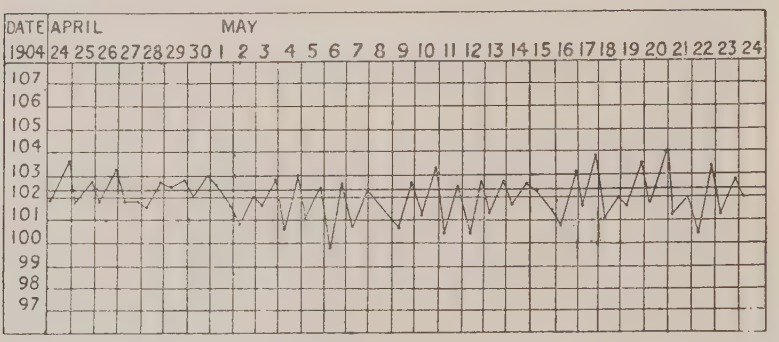
INJECT. 1.0 C.C. CULT. STREPTOCOCCI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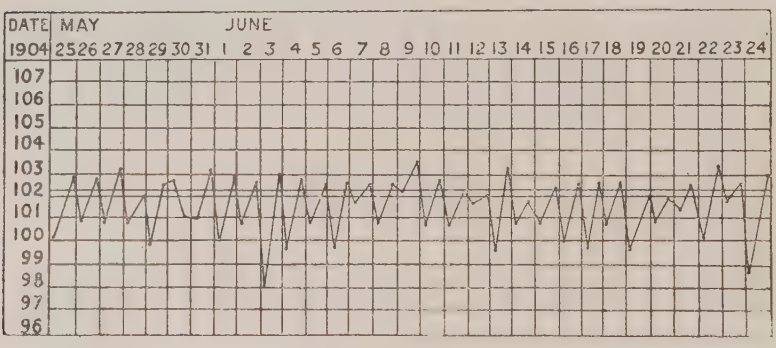
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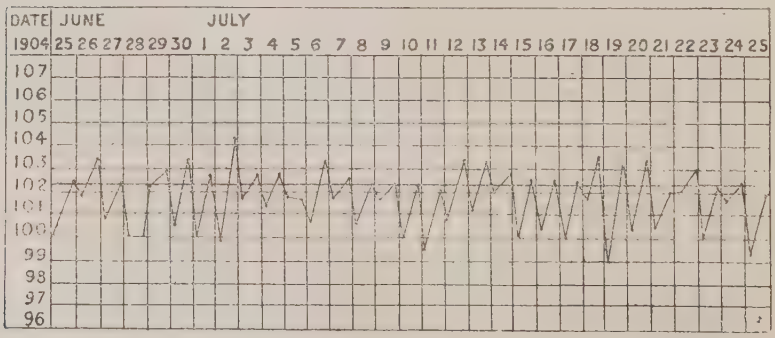
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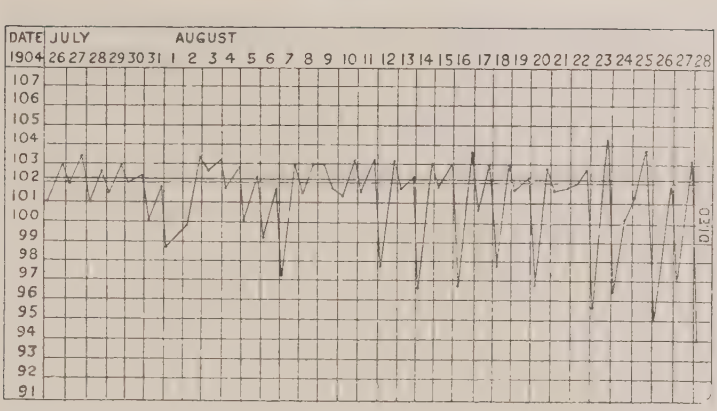


The following table shows the presence or absence of trypanosomes and streptococcus in the blood :—

Date.	Parasites in the blood.			Parasites in C.S.F.	
	Fil.	Mal.	Tryp.	Strept.	Tryp.
1903.					
April 9	...	–	–	...	...
„ 11	...	–	–	...	...
„ 23	...	–	–	...	...
„ 30	...	–	–	...	...
May 7	...	–	–	...	...
„ 14	...	–	–	...	...
„ 21	...	–	+	...	...
„ 28	...	–	+	...	...
June 4	...	–	+	...	...
„ 11	...	–	–	...	...
„ 18	...	–	+	...	...
„ 25	...	–	+	...	...
July 1	...	–	+	...	...
„ 23	...	–	+	...	...
„ 31	...	–	–	...	...
Aug. 7	...	–	–	...	...
„ 13	...	–	+	...	...
„ 20	...	–	+	...	...
„ 28	...	–	+	...	...
Sept. 4	...	–	+	...	...
„ 12	...	–	+	...	...
„ 25	...	–	–	...	...
Oct. 8	...	–	–	...	...
Nov. 5	...	–	–	...	...

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid from June 9th :—

Date 1904.	Parasites in the blood.			Parasites in C.S.F.	
	Filar.	Malar.	Tryp.	Strepto.	Tryp.
June 9	...	−	+	...	...
„ 16	...	−	+	...	...
„ 24	...	−	+	...	...
July 2	...	+	+	...	...
„ 15	...	+	+	...	...
„ 22	...	+	+	...	...
„ 30	...	+	+	...	...
Aug. 12	...	+	+	...	...
„ 19	...	−	+	...	...
„ 26	...	...	+	...	...
„ 27	...	...	+	...	+
„ 28	...	...	+	−	+

August 28, 1904. Animal killed by chloroform. Post-mortem at once.

The body is distinctly emaciated. The coat is very much out of condition. No sores. Pupils equal and normal. Slight general enlargement of lymphatic glands. Some increase of fluid in pericardial cavity, none in pleural or peritoneal.

Brain.—On removing the calvarium and reflecting the dura mater, there is seen to be some injection of superficial vessels, and slight flattening of the convolutions, otherwise nothing noteworthy. A culture in broth was made from the cerebro-spinal fluid—this remained sterile.

Spinal cord.—There is some hæmorrhage into the theca from the puncture, otherwise it is normal. Brain removed entire with spinal cord roots, ganglion, and nerves for future investigation.

Heart.—Nothing noteworthy. The blood of this organ contains many trypanosomes not modified in shape. A culture in broth was made from the blood, which remained sterile.

Lungs.—Both show minute areas of embolism studded through the substance. On microscopic examination these are seen to contain altered trypanosomes.

Peritoneal cavity.—On opening the cavity a number of "bladder-like" structures of various sizes containing fluid are seen in the folds of the peritoneum bulging into the cavity. To find out the exact relation of parts the whole abdominal contents were turned out and floated in water. After dissection it was determined that the "bladders," which were quite transparent, except for an opaque spot at one point and contained a clear fluid, lay between the layers of the omentum, and on cutting these through they became free. It was also seen that these "bladders" were embedded in the substance of the liver and bulged out of its substance on its various surfaces and became adherent to the surrounding structures. The fluid in the cysts was quite clear, some of it was centrifuged and examined under the microscope, but no hooklets or similar structures were seen.

Liver.—Removed entire for the further study of the cysts contained.

Spleen.—Slightly enlarged. Slight general enlargement of superficial area. No points of suppuration on section.

Remarks.—This is an interesting experiment because (1) It demonstrates the long course which the trypanosoma infection, as in man, may run (from inoculation until the death of the animal, nearly 18 months), and that only towards the close of life were the characteristic signs of the disease present. Both in men and in monkeys the malady may either run an acute, or, as in this case, a very chronic course. The disease in monkeys, therefore, has a strictly parallel course to that observed in man. (2) During the course of the trypanosome infection, when the temperature became somewhat irregular, but otherwise no marked signs were manifest, an injection of a pure culture of diplo-streptococcus rich in germs was made to determine the effect. The injection was followed by no effect, so far as could be observed, either locally or generally, and the animal sickened and died many months afterwards with a trypanosome infection. It is possible that the general condition of the animal was lowered by the state of the liver, which permitted the trypanosomes to get the upper hand.

Experiment 99. Monkey (*Cercopithecus sp.*).

To observe the effect of infection of the monkey by tsetse flies which had fed on a sleeping sickness patient 24 hours previously, and the effect of subcutaneous injection of a pure culture of diplo-streptococcus on the course of this infection.

July 23, 1903. Trypanosomes were noted in the blood for the first time; the feeding was begun on May 15, 1903.

January 15, 1904. Animal out of condition generally, but is still fairly active.

February 14. Animal is very weak and thin. He is crouched up and frequently his attitude is very characteristic, the head drooping between his knees.

February 22. Animal lies about a good deal. He takes his food better. His temperature is still swinging.

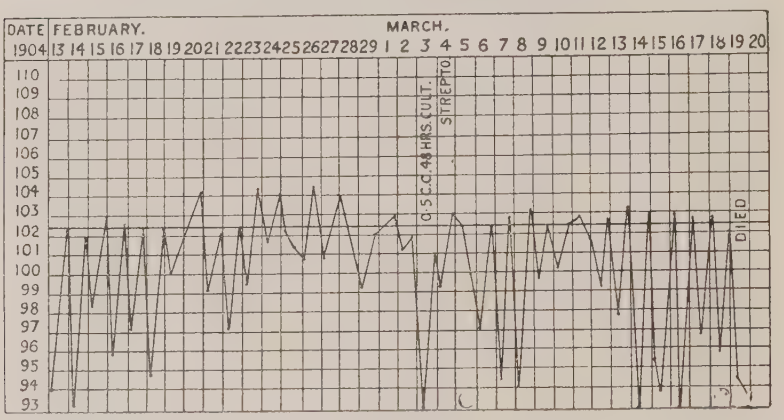
March 2. Injected under the skin of left thigh 0·5 c.c. culture in broth of a diplo-streptococcus obtained from the cerebro-spinal fluid of a case of sleeping sickness taken post-mortem. The growth was 48 hours old. It was proved to be a pure culture of diplococci by microscopic examination and by culture in agar. The growth was abundant and grew in the form of balls with clear fluid between.

March 13. The animal, as formerly, is in the usual characteristic attitude. The saliva tends to dribble from his mouth. The glands in his left groin are distinctly enlarged.

March 19. Animal is in a moribund condition, passing its motions under it and unable to rise. Saliva is dribbling from its mouth, a gland in right groin was distinctly enlarged; this

was removed and found to contain pus. Smears showed under the microscope diplococci and "bodies" stained blue which appeared to be degenerated trypanosomes.

The following chart shows the temperature curve:—



The following table shows the presence or absence of trypanosomes and streptococci in the lymph glands, blood and cerebro-spinal fluid:—

Date.	Parasites in glands		Parasites in blood.			Parasites in C.S.F.	
	Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1903.							
July 23	...	...	−	+	+	...	...
Aug. 3	...	...	...	+	+	...	...
„ 21	...	...	...	+	+	...	...
Sept. 25	...	...	...	+	+	...	...
Oct. 8	...	...	...	−	+	...	...
Dec. 10	...	...	...	−	−	...	...
„ 18	...	...	...	+	−	...	...
Jan. 15	...	...	...	+	+	...	...
„ 28	...	...	...	+	+	...	...
Feb. 8	...	...	...	+	+	...	...
„ 21	...	...	...	+	+	...	...
„ 29	...	...	...	+	+	...	...
Mar. 6	...	...	...	+	+	...	...
„ 13	...	...	...	+	+	...	...
„ 19	+	+	...	+	+	+	−

March 20. Animal died in the night. Post-mortem 9 a.m. The body is markedly emaciated. Lymphatic glands in both femoral regions are enlarged—glands in right femoral region are suppurating. Glands in axilla and neck are enlarged, but not suppurating. Pupils equal and normal. No increase of

fluid in pleural or peritoneal cavities, slight increase in pericardial.

Brain.—On removing the calvarium the dura mater is seen to be normal; on reflecting it, the convolutions are seen to be slightly flattened and the superficial vessels are injected; the sub-arachnoid fluid is increased—no active trypanosomes were seen microscopically, but the animal had been dead for some time. A pure culture of a streptococcus was obtained from the cerebro-spinal fluid.

Heart.—Nothing noteworthy. Blood from this organ examined microscopically showed many trypanosomes. Malaria is also present.

Lungs.—Are both healthy.

Liver, Spleen, and Kidneys.—Show nothing noteworthy.

Intestines.—Are healthy.

Lymph Glands.—In omentum and mesentery distinctly enlarged.

Remarks.—This experiment demonstrates several points of importance. The first being that it is possible to convey the trypanosoma of sleeping sickness from man to monkey after an interval of 24 hours. Secondly, that the disease produced in the monkey by the fly infection presents the same characters as that produced by inoculation of cerebro-spinal fluid or blood from a case of sleeping sickness. This animal presented towards the close of its life a typical picture of a sleeping sickness case.

This experiment is, finally, of interest and importance from the fact that 15 days before its death it had been injected with a pure culture of diplococci obtained from a case of sleeping sickness. So far as we could observe, the course of the disease was uninfluenced by the injection, the only noteworthy feature being a slight suppuration in one of the groups of lymphatic glands near the site of inoculation. Portions of the nervous system and glands have been preserved for minute investigation and the results of the examination will be of interest.

8. *Has the so-called Trypanosoma Fever any connection with Sleeping Sickness?*

Since the publication of the last Report the observations on the five men in whose blood the trypanosomes were first discovered in March, 1903, have been continued.

Two of these, Karala Barigi and Bara Risgallah, died of pneumonia in April and May, 1904, respectively; of the others, Jordien Murjan appears to be undoubtedly in an early stage of sleeping sickness. He has gradually developed the characteristic signs of the malady. Trypanosomes are now always found in his cerebro-spinal fluid. Tabula presents some of the features of the disease, but is still able to do his work and has not yet shown trypanosomes in the cerebro-spinal fluid.* Kumsarsabba is in a similar condition.

* Lieut. Gray writes, February, 1905, "That Tabula now shows trypanosomes in the cerebro-spinal fluid, and distinct signs of sleeping sickness."

In addition to the above, in order to extend the observations on this most important stage of the disease, five natives were picked out, from a batch of prisoners from Usoga, having enlarged glands in the neck. On examination trypanosomes were found in the lymph juice of each. These men are being kept in hospital and their condition is being carefully observed. We have also observed the action of arsenic on the *Trypanosoma gambiense* in these men. None of them show any of the characteristic features of sleeping sickness, and the trypanosomes are not present in the cerebro-spinal fluid. In fact, with the exception of enlargement of the lymphatic glands and slight fever the general condition of the men is good.

The importance of this stage of the disease is so great that a full account of the observations on these five natives is given. The diet has been increased, in addition to bananas, a ration of meat is given twice weekly. It will be seen from the tables that since admission the trypanosomes are less frequently found in the lymphatic glands and blood. Up to date they have improved remarkably in general condition and have rapidly put on flesh. The after history of these cases, maintained under the above conditions, will be of considerable interest.

Experiment 31. Karala Barigi. Male.

District, Singo. Occupation, policeman. Tribe, Mundu, Nubian.

April 24, 1903. Patient states that he has been six months in Entebbe. His illness began on March 10. He asserts that at present he feels quite well and has no headache or other symptoms. There are no enlarged glands in the neck, but in the axillæ they are as large as peas and they are also enlarged in the groin. His tongue is moist and furred. His speech is fluent. Pulse 120, fair. His heart sounds are normal.

September 23, 1903. There is slight general enlargement of the lymphatic glands. Slight tremor of hands and tongue.

February 6, 1904. Glands distinctly enlarged in the left post triangle of neck. Cerebro-spinal fluid flowed out very freely, a few flakes in it.

April 4. There is slight œdema of right leg, which he states has been present for about a month. Tremors of hands present. Glands distinctly enlarged in both posterior triangles. A gland was excised from the right posterior triangle. A drop of the juice of this gland examined under the microscope showed many active trypanosomes. Stained preparation showed well-formed trypanosomes and also many apparently modified trypanosomes. Gland was preserved for further examination.

April 16. There is œdema of both feet and legs. He was admitted into the native hospital to-day for double pneumonia.

The temperature remained practically normal up to the onset of the pneumonia.

The following table shows the presence or absence of trypanosomes in the lymphatic glands, blood, and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	S.M.	L.M.	P.	E.	Hb. Per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
								Filar.	Tryp.	Filar.	Malar.	Tryp.	Tryp.	Filar.
1903.														
March 12	...	...	...	...	...	...	...	...	...	...	...	+	...	...
„ 13	...	...	...	...	...	...	...	...	...	...	...	+	...	...
„ 14	...	...	...	...	...	...	...	...	...	...	...	+	...	...
„ 15	...	...	...	...	...	...	...	...	...	...	...	+	...	...
April 17	...	...	...	...	...	...	...	...	...	...	...	+	...	...
March 24	...	...	...	...	...	...	...	...	...	...	...	...	−	−
May 6	...	...	...	...	...	...	...	...	...	...	...	...	−	−
„ 16	...	...	...	...	...	...	...	...	...	...	...	...	−	−
„ 19	...	...	...	...	...	...	...	...	...	+	...	−	...	...
„ 26	...	...	...	...	...	...	...	...	...	...	...	+	...	...
June 24	...	...	...	...	...	...	...	...	...	...	...	+	−	−
July 24	...	...	...	...	...	...	...	...	...	+	...	+	+	...
Aug. 17	...	...	...	...	...	...	...	...	...	...	...	+	+	...
Sept. 23	...	...	...	...	...	...	...	...	...	...	...	...	−	...
Nov. 11	...	...	...	...	...	...	...	...	...	+	...	+	−	...
Dec. 22	...	...	...	...	...	...	...	...	...	+	...	+	−	...
								...	...	+	...	+	−	...
1904.														
Feb. 6	...	...	...	...	...	...	...	...	...	+	...	+	+	...
April 4	...	22,500	32	10	53	5	...		+	−	...	...	...	...
„ 16	...	27,500	9	13	78	0	...	...	...	+	...	...	...	...

April 18. Patient died this morning. It is much to be regretted that no post-mortem examination could be made on this very important case.

Case 64. Jordien Murjan. Male. Age 36.

District, Muru. Nubian. Prisoner for last three years.

March 31, 1903. Admitted to hospital. He is an old Soudanese mutineer and lives as a prisoner in the jail.

No fellow prisoners have had sleeping sickness. He has no œdema, and no noticeable swelling of glands. His tongue is healthy, but shaky. There is no tremor of the hands. His speech is normal and pulse 144.

August 18. This patient at the present date has not any marked symptoms of sleeping sickness. At the same time there is slight general enlargement of lymphatic glands, his expression is dull, there is some tendency to tremor of the tongue and fingers and his pulse is rapid.

September 21. Expression is dull and heavy. Complains of no pains. Appetite good. Pulse 136. Slight tremors of tongue and fingers.

November 9. No definite signs of sleeping sickness. Pulse 120. Fine tremors of tongue.

December 26. Tremors of fingers distinct. Trypanosomes present in cerebro-spinal fluid.

February 1, 1904. General condition as before.

March 21. A gland in left anterior triangle of neck was removed; active trypanosomes were present in the juice.

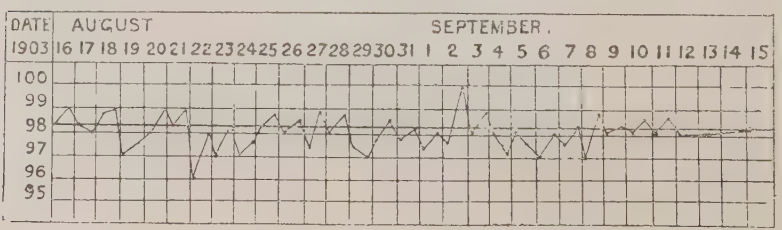
June 7. Pulse 104. No pain. Tremors of hands and tongue present. Œdematous swelling of both legs. Cerebro-spinal fluid contains active trypanosomes—no red cells. He is reported to be "very dull and stupid and fit for very little work."

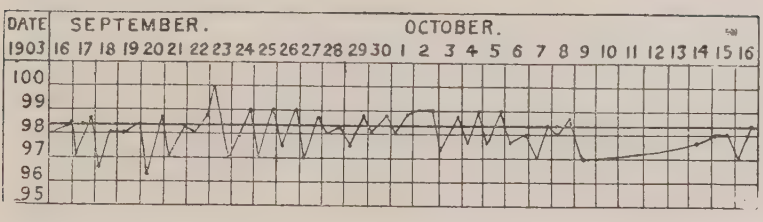
July 18. Complains of pain in head, arms and chest, also of itching. Pulse 125. Active trypanosomes in cerebro-spinal fluid; no red cells in deposit.

August 25. Complains of no pain. Pulse is 120. Œdema of right foot. Trypanosomes present in cerebro-spinal fluid; no red cells.

October 2. Tremors of hand. No pain. Slight œdematous swelling of left foot. Trypanosomes in cerebro-spinal fluid; no red cells in deposit.

The following chart shows the course of the disease:—




DATE
SEPTEMBER.
OCTOBER.
1903 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
100
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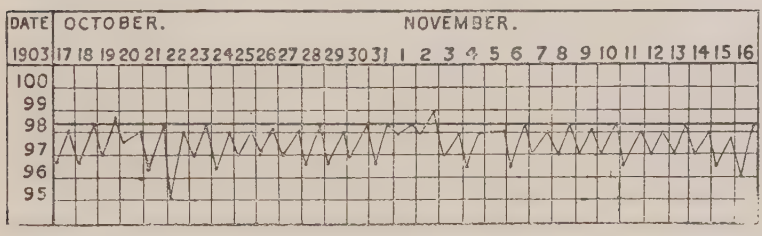
97
96
95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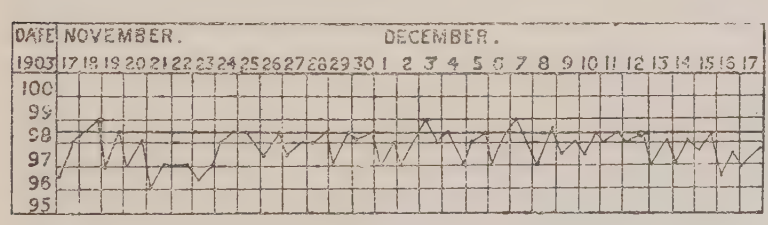
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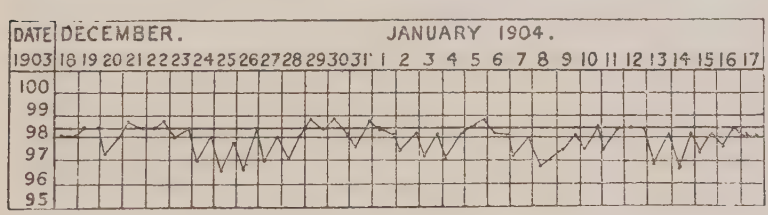
DATE
DECEMBER.
JANUARY 1904.
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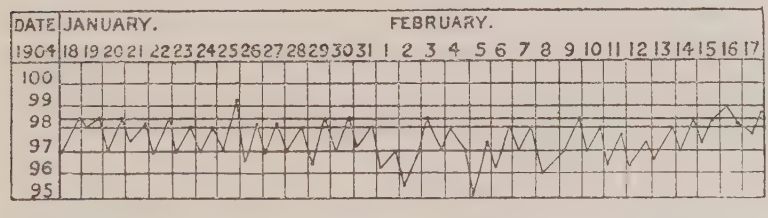
DATE
JANUARY.
FEBRUARY.
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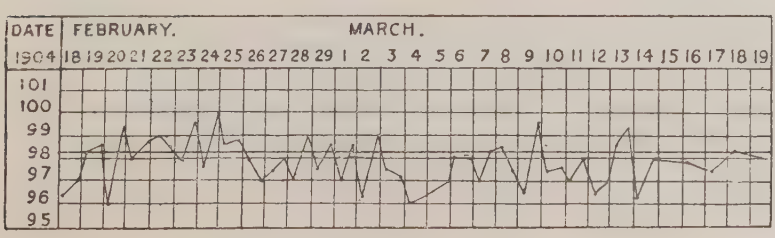
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MARCH.
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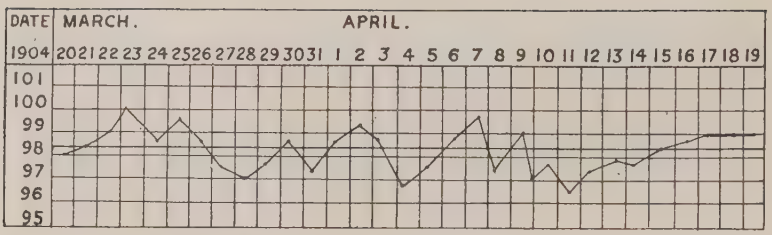
DATE
MARCH.
APRIL.
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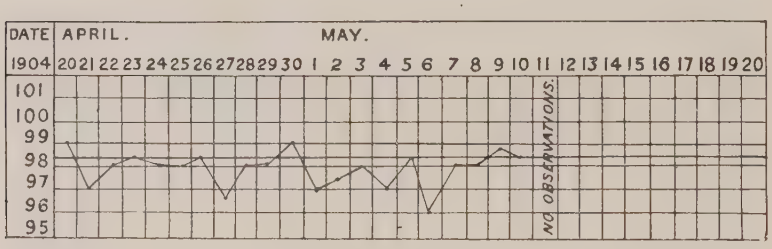
DATE
APRIL.
MAY.
1904 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
NO OBSERVATIONS.
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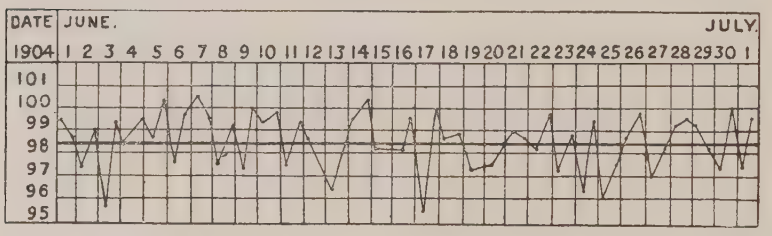
DATE
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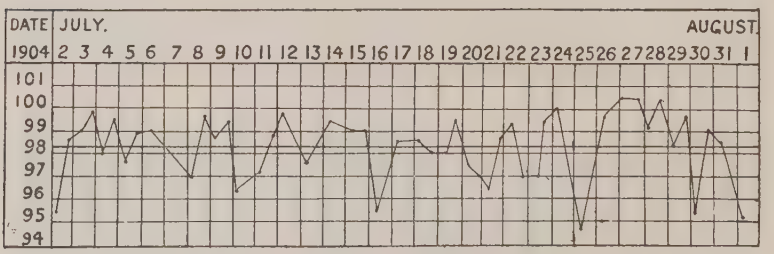
DATE
JULY.
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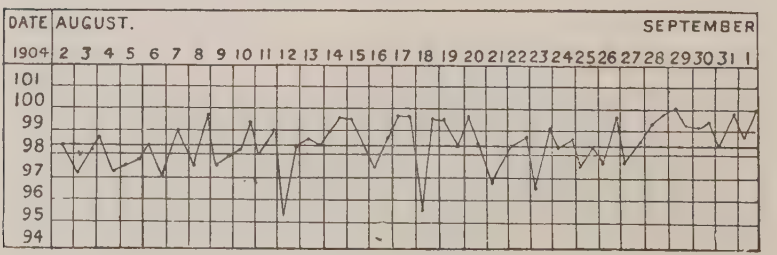
DATE
AUGUST.
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1904 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1
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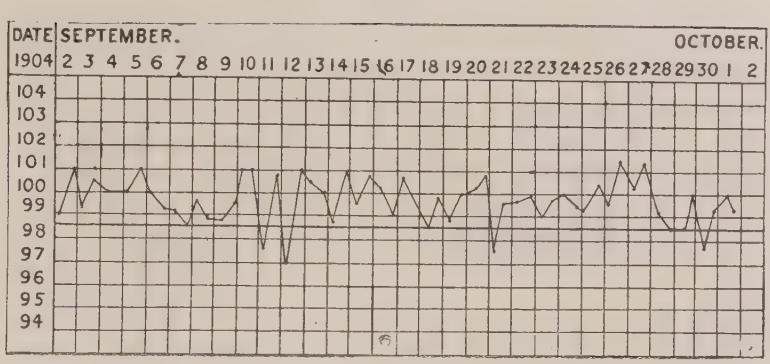
DATE
SEPTEMBER.
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2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2
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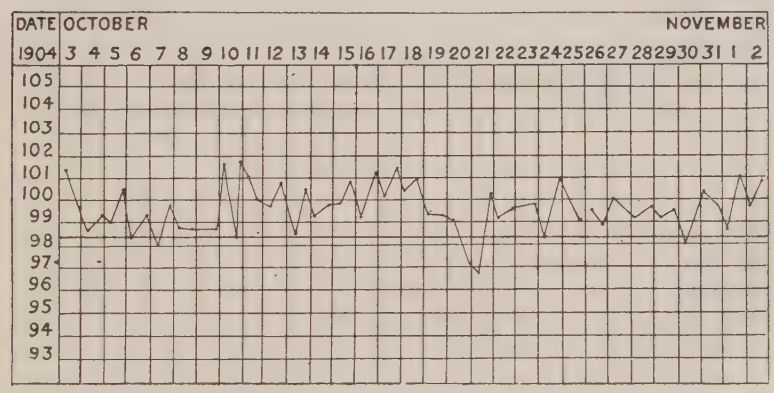
94


DATE
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3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2
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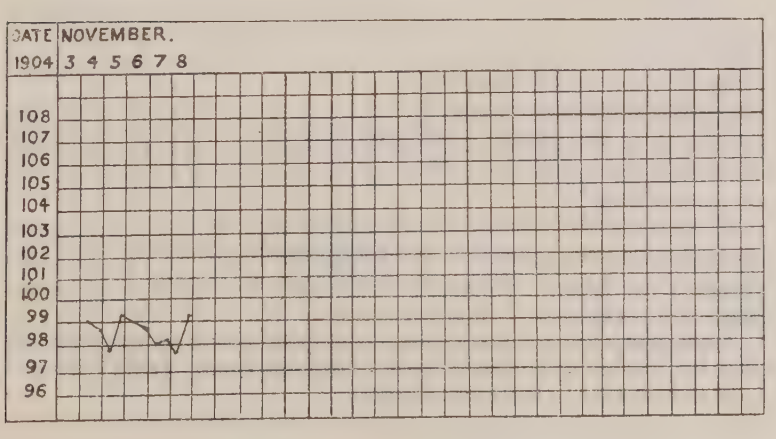
DATE
NOVEMBER.
1904
3 4 5 6 7 8
108
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104
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The following table shows the presence or absence of trypanosomes in the lymphatic glands, blood and cerebro-spinal fluid:—

Date.	Parasites in Glands.		Parasites in the Blood.			Parasites in C.S.F.	
	Strepto.	Tryp.	Filar.	Malar.	Tryp.	Strepto.	Tryp.
1903.							
March 31	...	...	...	...	+	...	−
April 1	...	...	...	...	+	...	...
„ 2	...	...	...	...	+	...	...
„ 3	...	...	...	...	+	...	...
„ 17	...	...	...	...	...	...	−
May 1	...	...	−	...	+	...	−
„ 11	...	...	...	...	+	...	−
„ 25	...	...	...	...	+	...	−
June 9	...	...	...	...	+	...	−
„ 23	...	...	...	...	+	...	−
July 22	...	...	...	...	+	...	+
Aug. 18	...	...	...	...	...	...	+
Sept. 21	...	...	−	...	+	...	−
Nov. 9	...	...	−	...	+	...	−
Dec. 26	...	...	−	...	+	...	+
1904.							
Feb. 1	...	...	−	...	+	...	−
March 21	...	...	−	...	+	...	−
June 7	...	+	−	...	+	...	+
July 18	...	+	...	...	−	...	+
Aug. 25	...	+	...	...	+	...	+
Oct. 2	...	+	...	...	+	...	+

EXPERIMENT 68. BARA RISGALLAH (MALE). AGE 35 YEARS.

Trypanosoma fever. Tribe Lendu. Occupation police. Lives in hut in police lines.

April 21, 1903. Admitted to hospital. This man states he had been ill ten days, and that the ailment began with a shivering fit. He also says he had a sickness like this in Kampala four or five years ago.

April 24. Patient looks ill. There is no œdema and only the glands in the groin are slightly enlarged. His pulse is 108, feeble and compressible. The heart sounds are normal. He has no tremors.

November 10. Patient fell asleep while on duty during the day. Some enlargement of lymphatic glands in anterior triangles of neck. Distinctly enlarged in axilla and groin. Pulse 160 weak.

December 19. Patient was in hospital for synovitis of left knee and œdema of both legs. He has been lying about a good deal lately. Pulse 96 feeble.

February 8, 1904. Patient looks dull and heavy. Pulse 108.

March 30. Glands enlarged in both triangles of neck. Pulse 100. Rather emotional—fits of weeping. Tremors of hands. Gland excised from right anterior triangle contained active trypanosomes. No streptococci seen in the films of the juice.

April 27. Admitted to hospital complaining of cough and fever. There was slight œdema of both legs near ankles. Slight impairment of note at right apex. Breathing rapid. Sputum is watery.

May 1. Percussion of chest shows dulness both anteriorly and posteriorly on the right side more marked at upper part of chest. Vocal fremitus is increased. Breath sounds are bronchial in character and are accompanied by crepitations. Sputum is sticky—has a rather greenish colour.

May 4. Dulness is marked all over chest on right side anteriorly and posteriorly. Liver extends four inches below costal margin. Some jaundice of conjunctivæ.

The temperature remained normal up to the onset of the pneumonia:—

The following table shows the result of enumeration of the blood corpuscles, the presence or absence of trypanosomes in glands, blood and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	S.M.	L.M.	P.	E.	Hb. Per cent.	Parasites in glands.		Parasites in blood.			Par. in C.S.F.	
								Filar.	Tryp.	Filar.	Mal.	Tryp.	Tryp.	Strepto.
1903.														
April 21 ...	...	...	...	...	...	...	...	–	...	+	...	+	–	...
May 4 ...	...	...	...	...	...	...	...	...	...	...	...	+	–	...
„ 11 ...	...	...	...	...	...	...	...	...	...	–	...	+	...	...
„ 26 ...	...	...	...	...	...	...	...	...	...	+	...	+	–	...
June 24 ...	...	...	...	...	...	...	...	...	...	+	...	+	–	...
July 24 ...	...	...	...	...	...	...	...	...	...	+	...	+	–	...
October 24 ...	...	...	...	...	...	...	...	...	...	–	...	+	...	...
November 10...	...	...	...	...	...	...	...	...	...	–	...	–	–	...
December 19 ...	...	...	...	...	...	...	...	...	...	+	...	–	–	...
1904.														
February 8 ...	...	...	...	...	...	...	...	...	...	+	...	–	–	...
March 30 ...	...	6,870	29	11	59	1	...	–	+	–	...	–	...	...
April 26 ...	...	...	23	8	69	0	...	...	...	...	...	...	...	...
„ 27 ...	4,500,000	6,200	14	8	78	...	...	...	...	...	...	...	...	...
„ 29 ...	3,800,000	17,800	10	11	79	...	66	...	...	...	...	...	...	...
„ 29 ...	3,600,000	15,000	6	7	87	...	66	...	...	...	...	...	...	...
„ 30 ...	3,900,000	16,200	22	6	72	...	70	...	...	...	...	...	...	...
May 2... ...	3,500,000	15,500	13	4	83	...	68	...	...	...	...	...	...	...
„ 3... ...	3,800,000	27,100	7	7	86	...	75	...	...	...	...	...	...	...
„ 4... ...	4,000,000	26,500	6	4	90	...	80	...	...	...	...	...	...	...

May 5, 1904. Patient died at 5 a.m. Post-mortem one hour after death.

The body is that of a well built and fairly well nourished man. General enlargement of superficial lymphatic glands. Pupils normal and equal.

On opening the body a considerable quantity of straw coloured fluid escaped from the right pleural cavity, no increase of pericardial or peritoneal.

Brain.—On removing the calvarium the dura mater is found to be normal. On reflecting that membrane the sulci of the convolutions of the brain were seen to be filled up with jelly-like exudation. The superficial vessels showed some injection and the convolutions were somewhat flattened. Towards the base of the brain over the medulla, pons and cerebellum there was a considerable amount of exudation of a thicker nature. The general appearance of the brain somewhat resembled that met with in cases of sleeping sickness. Cerebro-spinal fluid was increased; 5 c.c. were centrifuged, but no active trypanosomes were found. A cocco-bacillus was present. Portions of the brain were preserved for further examination.

Heart.—Muscle is pale and flabby, otherwise healthy.

Lungs.—Right, there is some recent lymph on surface, the whole lung being in a state of pneumonic consolidation. The upper lobe being in a state of grey hepatisation, the lower showing a condition of red hepatisation. Left is healthy.

Liver.—Is markedly enlarged, extends four inches below costal margin. On section, is pale and bile stained.

Spleen.—Distinctly enlarged, capsule is thickened, firm on section.

Kidneys.—Nothing noteworthy, intestines normal.

Glands.—Deep cervical are distinctly enlarged. Smears of the glands showed no streptococci, no fully formed trypanosomes were seen.

Remarks.—This man originally came under observation as a case of trypanosoma fever. For the past year his blood, glands and cerebro-spinal fluid have been regularly examined. During life he had several of the signs and symptoms met with in sleeping sickness cases, viz., enlargement of the lymphatic glands and œdema, and others indicating early involvement of the nervous system, *i.e.*, rapid pulse, tendency to drowsiness, tremors and alteration of the facial expression.

Post-mortem the brain presented an appearance resembling that met with in sleeping sickness cases. During the attack of pneumonia he did not present any symptoms indicating acute meningeal change. Although trypanosomes were not found in the cerebro-spinal system, they were abundant in the lymph system, as an examination of the glands showed. This man was almost certainly in a fairly early stage of sleeping sickness.

This experiment should be compared with No. 58.

CASE 302. TENWA. MALE. AGE 25.

District. Usoga.

June 7, 1904. Patient was selected from a group of prisoners from Usoga, on account of enlarged glands in the neck. He asserts that he is quite well. Beyond general lymphatic enlargement, there are no signs of sleeping sickness. The lymph from a gland in the left posterior triangle of the neck was examined and found to contain many active trypanosomes.

July 2. Intra-muscular injections of arsenious acid were begun.

October 16. The general condition of the patient has much improved.

The temperature remained about normal. Slight elevation occurred from time to time, and this was associated with the presence of the parasite in the blood.

The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the amount of arsenious acid administered, the presence or absence of trypanosomes in the lymphatic glands, blood and cerebro-spinal fluid:—

Date 1904.	R.B.C.	W.B.C.	Hb. per cent.	Percentages.				Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
				P.N.	S.M.	L.M.	Eos.	Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
June 7 ...	3,700,000	6,000	66	38	46	13	3	–	+	–	–	–	...	–	...
„ 21, 10 a.m.	3,800,000	10,600	70	31	45	22	2	–	+		–	–	...	...	...
„ 22, „	3,900,000	11,200	72	...	...	...	...	–	+	...	...	...	...	...	...
„ 28, 10 p.m.	...	...	...	...	...	...	...	...	...	–	–	+	...	...	...
„ 30, „	...	...	...	...	...	...	...	...	...	–	–	+	...	...	...
July 2, 10 a.m.	4,200,000	7,500	74	39	53	2	6	...	+	+	–	+	...	...	...
„ 3 ...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	10
„ 4, „	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15
„ 5, „	4,100,000	10,000	72	43	46	4	7	...	+	+	–	–	...	...	15
„ 6 ...	...	...	...	...	...	...	...	...	+	+	–	–	...	...	18
„ 7 ...	...	...	...	30	59	4	7	...	–	...	...	...	...	...	20
„ 7 ...	...	...	...	...	...	...	...	...	–	...	...	–	...	...	20
„ 8 ...	...	...	...	33	61	3	3	...	–	...	...	...	...	...	...
„ 11 ...	4,000,000	6,850	68	30	64	3	3	...	–	...	...	–	...	...	...
„ 16 ...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	...
„ 17 ...	4,300,000	6,600	74	14	69	9	8	...	...	...	...	...	...	...	20
„ 25 ...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	...
„ 26 ...	4,300,000	9,700	72	43	37	14	6	...	...	...	...	...	...	...	...
„ 28 ...	...	...	...	29	46	10	15	...	...	...	...	+1	...	...	...
„ 31 ...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	...
Aug. 3... ...	...	...	...	...	...	...	...	...	–	...	...	...	...	...	...
„ 6... ...	...	...	...	42	43	5	10	...	...	...	...	–	...	...	...
„ 8... ...	...	...	...	31	50	3	16	...	...	...	...	+	...	...	20
												–	...	...	...

Date 1904.	R.B.C.	W.B.C.	Hb. per cent.	Percentages.				Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
				P.N.	S.M.	L.M.	Eos.	Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
Aug. 11...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	...
„ 14...	...	...	...	23	48	14	5	...	...	...	...	+1	...	...	...
„ 18...	...	...	...	26	43	8	23	...	...	...	...	–	...	...	...
„ 22...	...	...	...	...	...	...	...	...	...	...	...	–	...	...	...
„ 25...	...	...	...	22	54	10	14	...	...	...	...	–	...	...	...
„ 27...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
„ 28...	...	...	...	...	...	...	...	...	–	+	–	–	...	...	...
„ 29...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...
„ 31...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...
Sept. 3...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 9...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 15...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 24...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 26...	...	4,800,000	10,000	72	22	50	8	20	...	...	...	+	–	–	...	...	...
„ 28...	...	...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 29...	...	...	...	...	...	...	...	...	...	...	—	+	–		...	...	...
„ 30...	...	...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
Oct. 3...	...	...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...
„ 7...	...	...	...	...	...	...	...	...	...	...	...	+	–		...	...	...
„ 10...	...	...	...	...	...	...	...	...	...	...	...	–		–	...	...	...
„ 17...	...	...	...	...	...	...	...	...	...	...	...	–		–	...	...	...
„ 21...	...	...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...
„ 28...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...	...	...
Nov. 4...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...

Case 303. Kitsame. Male. Age 26.

District. Usoga.

June 7, 1904. This man is also a prisoner, and was selected on account of enlarged glands, otherwise he presents no signs of sleeping sickness. The lymph obtained from a gland in the left posterior triangle of the neck contained many active trypanosomes.

June 21. Intra-muscular injections of arsenious acid were commenced.

The temperature remained about normal. Occasional slight rises were associated with the presence of trypanosomes in the blood.

The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the amount of arsenious acid administered, the presence or absence of trypanosomes in the lymphatic glands, blood and cerebro-spinal fluid:—

Date 1904.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
June 7	4,800,000	12,500	47	30	21	2	80	–	+	–	–	+	...	...	...
„ 21, 9.30 a.m.	4,500,000	10,900	52	29	12	7	72		+	...	...	+ 3	per 100 leucocytes.		5
„ 22, 9.30 „	4,600,000	10,930	53	33	10	4	74	–	+	...	...	+ 4	...	...	...
„ 22, 10.30 p.m.	4,600,000	...	43	47	7	3	74	...	...	...	...	+ 8	...	...	...
„ 23, 10.30 a.m.	4,700,000	9,000	42	49	8	1	74		+	...	...	+ 3	...	...	7
„ 23, 4 p.m.	...	...	44	42	10	4	...	...	...	...	...	+ 1	...	...	...
„ 23, 10 „	...	...	41	46	7	6	...	...	...	...	...	+10	...	...	...
„ 24, 11 a.m.	4,600,000	8,000	42	44	9	1	76	–	+	...	...	+ 2	...	...	...
„ 25, 11 „	4,500,000	6,000	46	42	4	8	80	...	...	...	...	–	...	...	9
„ 25, 4 p.m.	...	...	45	40	11	4	...	...	...	...	...	+ 1	Speckly form only.		
„ 25, 10 „	...	...	39	54	3	4	...	...	...	...	...	–	...	...	...
„ 26, 3 „	4,500,000	5,600	33	55	7	5	80	...	...	...	+ ?	+ 1	...	...	...
„ 27, 10 a.m.	4,600,000	5,600	41	50	5	4	82	...	+	...	...	–	...	...	11
„ 27, 4 p.m.	...	...	32	56	8	4	...	...	...	...	...	+ 1	...	...	...
„ 27, 10 „	...	...	35	55	6	4	...	...	...	...	...	–	...	...	...
„ 28, 11 a.m.	4,700,000	5,000	33	56	6	5	82	...	+	...	...	+ 2	...	...	12
„ 28, 4 p.m.	...	...	39	49	5	7	...	...	...	...	...	+ 4	altered forms.		...
„ 28, 11 „	...	...	40	50	4	6	...	...	...	...	...	–	...	...	...
„ 29, 11 a.m.	4,400,000	5,300	32	54	5	9	80	...	+	...	...	–	...	...	14
„ 29, 4 p.m.	...	...	41	50	4	5	...	...	...	...	...	+ 2	...	...	...
„ 29, 11 „	...	...	40	48	5	7	...	...	...	...	...	–	...	...	...
„ 30, 2 „	4,300,000	5,000	37	54	4	5	80	...	+	...	...	+ 1	...	...	16
„ 30, 11 „	...	...	34	60	4	2	...	...	...	...	...	+ 1	...	...	...
July 1, 11 a.m.	4,500,000	5,000	44	48	5	3	78	...	–	...	...	–	...	...	20

Date 1904.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
July 1	...	...	34	55	4	7	...	...	...	+	–	–	...	...	...
„ 2	4,600,000	5,000	39	51	4	6	80	...	–	...	...	–	...	...	22
„ 3	4,300,000	5,600	48	41	5	6	76	...	–	...	...	–	...	...	20
„ 4	4,000,000	5,000	32	62	4	2	78	...	–	...	...	–	...	...	nil
„ 5	4,300,000	3,900	20	70	7	3	76	...		...	...	–	...	...	„
„ 6	4,350,000	3,800	19	77	3	1	78	...	–	...	...	–	...	...	„
„ 7	4,500,000	3,800	14	74	8	4	74	...	–	...	...	–	...	...	...
„ 7	...	...	15	76	4	5	...	...	–	...	...	–	...	...	20
„ 8	4,200,000	3,800	25	61	2	12	72	...	...	...	...		...	...	nil
„ 11	...	...	28	56	5	11	...	...	–	...	...	–	...	...	...
„ 16	...	...	...	...	...	...	...	...	–	...	...	...	...	...	20
„ 17	4,900,000	5,800	20	58	13	9	80	...	...	...	...	–	...	...	...
„ 25	...	...	...	...	...	...	...	...	–	...	...	–	...	...	nil
„ 26	5,000,000	5,800	42	39	9	10	82	...	...	...	...	+ 37	..	...	...
„ 27	...	...	21	65	9	5	...	...	...	...	...	+ 1	...	...	...
„ 28	...	...	19	57	10	14	...	...	-	...	...	...	...	...	...
„ 31	...	...	28	47	8	17	...	...	...	...	...	...	...	..	...
Aug. 3	...	...	33	35	8	24	...	...	...	...	...	+ 1	...	...	...
„ 6	...	...	...	...	...	...	...	...	...	...	...	+	...	...	...
„ 3	...	...	29	50	10	11	...	...	...	...	...	–	...	...	...
„ 11	...	...	...	...	...	...	...	...	...	...	...		...	...	...
„ 14	...	...	22	44	9	22	...	...	...	...	...	+ 1	...	...	...

Date. 1904.	R.B.C.	W.B.C.	Percentages.				H.B. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3. in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
August 18 ...	...	...	46	35	6	13	...	...	...	—	—	—	...	...	...
„ 22 ...	...	...	23	49	8	20	...	...	...	—	—	—	...	...	...
„ 25 ...	...	...	28	49	8	15	...	...	...	—	—	—	...	...	...
„ 27 ...	...	...	...	...	...	...	...	—	—	—	—	—	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 29 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 31 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
September 3 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 9 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 15 ...	...	...	...	...	...	...	...	...	...	—	—	+ 2	...	...	...
„ 24 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 26 ...	5,000,000	10,900	30	36	4	30	86	...	...	—	—	+ 1	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 29 ...	...	...	...	...	...	...	...	—	—	—	—	—	...	...	...
„ 30 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
October 3 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 7 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 10 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 17 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 21 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...
November 4 ...	...	...	...	...	...	...	...	...	...	—	—	—	...	...	...

Case 304. Manawa. Male. Age 25.

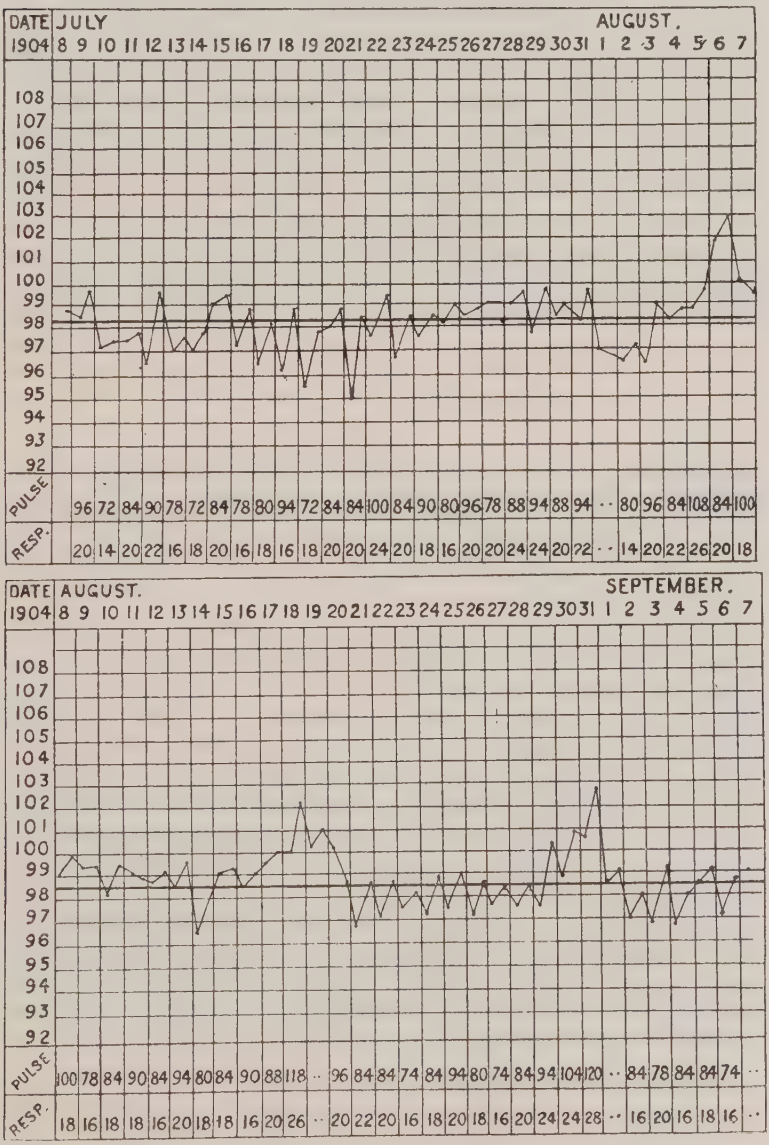
District. Usoga.

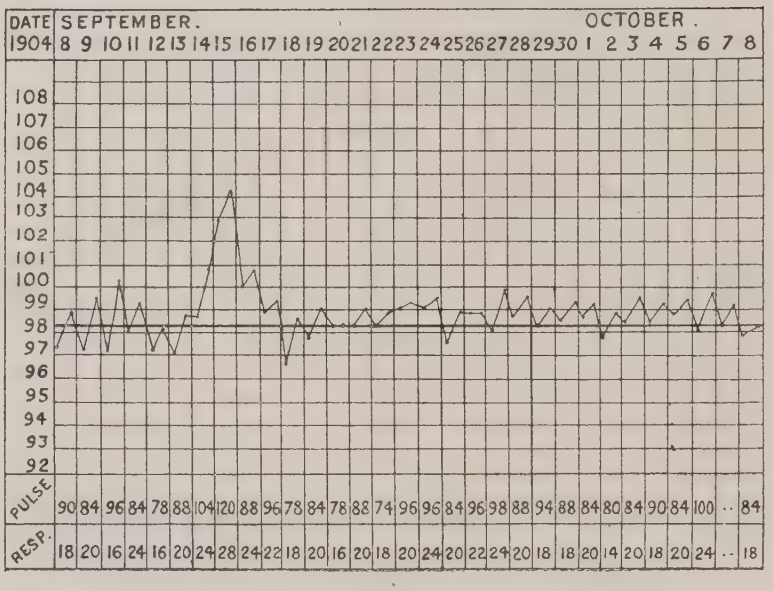
June 12, 1904. This man was also selected on account of enlarged glands in the neck. His general condition was good. The juice from a gland in the left posterior triangle of the neck was examined and was found to contain many active trypanosomes.

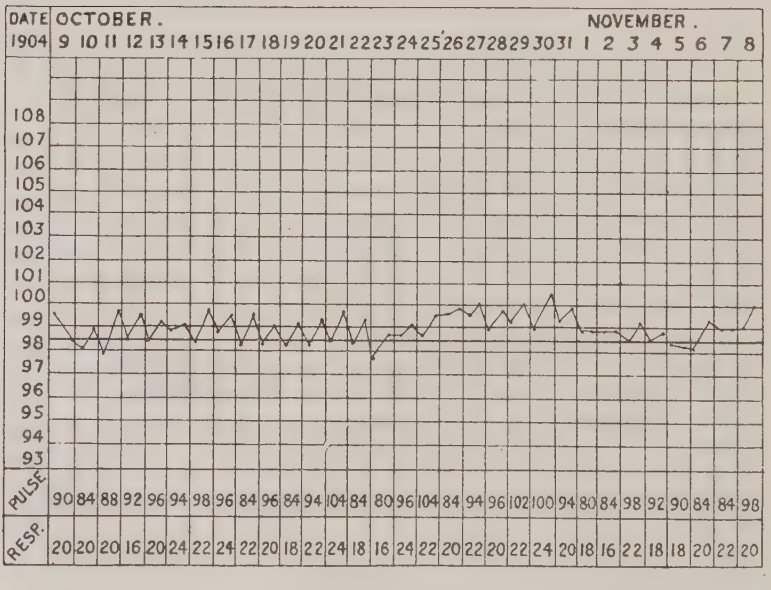
July 8. Intra-muscular injections of arsenious acid were commenced.

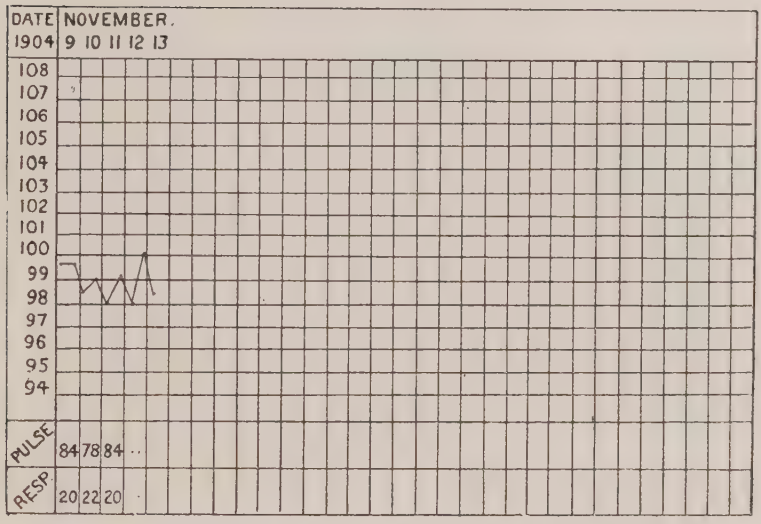
October 16. The general health of the patient is good.

The following chart shows the course of the disease :—




DATE 1904
SEPTEMBER.
OCTOBER.
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8
108 107 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92
PULSE
90 84 96 84 78 88 104 120 88 96 78 84 78 88 74 96 96 84 96 98 88 94 88 84 80 84 90 84 100 -- 84
RESP.
18 20 16 24 16 20 24 28 24 22 18 20 16 20 18 20 24 20 22 24 20 18 18 20 14 20 18 20 24 -- 18


DATE 1904
OCTOBER.
NOVEMBER.
9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
108 107 106 105 104 103 102 101 100 99 98 97 96 95 94 93
PULSE
90 84 88 92 96 94 98 96 84 96 84 94 104 84 80 96 104 84 94 96 102 100 94 80 84 98 92 90 84 84 98
RESP.
20 20 20 16 20 24 22 24 22 20 18 22 24 18 16 24 22 20 22 20 22 24 20 18 16 22 18 18 20 22 20



The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the amount of arsenious acid administered, the presence or absence of trypanosomes in the lymphatic glands, blood and cerebro-spinal fluid :—

Date. 1904.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Filar.	Malar.	Tryp.	Strept.	Tryp.	
												Per cent.			
June 12... ...	4,650,000	13,120	33	28	30	9	66	...	+	+	−	−	...	−	...
July 8... ...	4,500,000	11,200	24	44	15	17	78	...	+	+		−	...	...	10
„ 9... ...	...	...	...	...	...	...	...	...	+	...	...	−	...	...	15
„ 10... ...	4,800,000	11,870	33	41	18	8	78	...	+	+	...	−	...	...	20
„ 11... ...	...	...	...	...	...	...	...	...	−	...	...	...	...	...	nil
„ 12... ...	...	...	...	...	...	...	...	...	+scanty	...	...	...	...	...	20
„ 13... ...	...	...	...	...	...	...	...	...	−	...	...	...	...	..	20
„ 16... ...	...	...	...	...	...	...	...	...	−	+	−	−	...	...	20
„ 17... ...	4,600,000	9,100	28	63	6	3	80	...	...	+	−	−	...	...	nil
„ 25... ...	4,500,000	7,500	15	69	8	8	80	...	...	+	−	−	...	...	„
„ 31... ...	...	...	...	...	...	...	...	...		...	...	...	...	...	„
Aug. 6... ...	...	...	35	52	7	6	...	...	...	+	...	+5	...	...	„
„ 8... ...	...	...	11	69	13	7	...	...	+	+	...		...	...	„
„ 11... ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	„
„ 14... ...	...	...	32	52	6	10	...	...	...	−	−	−	...	...	„
„ 18... ...	...	...	34	42	12	12	...	...	...	−	−	+2	...	...	„
„ 22... ...	...	...	...	...	...	...	...	...	...	+		−	...	...	„
„ 25... ...	...	...	37	50	8	5	...	...	...	−	−	−	...	...	...
„ 27... ...	...	...	...	...	...	...	...	...	−	...	...	−	...	...	...
„ 28... ...	...	...	...	...	...	...	...	...	...	+	−	−	..	...	...
„ 29... ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 31... ...	...	...	...	...	...	...	...	...	...	+	−	+1	...	...	...
Sept. 3... ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...

Date. 1904.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Filar.	Malar.	Tryp.	Strept.	Tryp.	
												Per cent.			
Sept. 9 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	nil
„ 13...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 15...	...	...	...	...	...	...	...	...	...	+	−	+7	...	...	...
„ 24...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 26...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 28...	...	5,000,000	12,500	19	58	11	12	88	...	...	−	−	−	...	...
„ 29...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
„ 30...	...	...	...	...	...	...	...	...	−	−	−	−	...	...	...
Oct. 3 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
„ 7 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 10 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 17 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 21 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
Nov. 4 ...	...	...	...	...	...	...	...	...	...	+	−	−	...	...	...
										−	−	−	...	...	...

Case 310. Mondu. Male. Age 25.

District. Usoga.

July 8, 1904. This case was also selected from a group of prisoners. He had general enlargement of the superficial lymphatic glands, but no signs of sleeping sickness. The juice from a gland in the right posterior triangle of the neck was examined and found to contain many active trypanosomes.

July 10. Intra-muscular injections of arsenious acid were commenced.

October 10. The general health of the patient is good.

The temperature remained about normal. Occasional slight rises were associated with the presence of trypanosomes in the blood.

The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the amount of arsenic administered, the presence or absence of trypanosomes in the blood, lymphatic glands and cerebro-spinal fluid :—

Date. 1904.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
July 9 ...	5,200,000	8,700	47	28	5	10	85	−	+	+	−	+1	...	...	...
„ 10 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10
„ 11 ...	...	...	...	...	...	...	...	...	+	...	...	...	...	...	15
„ 12 ...	5,100,000	9,000	42	40	6	12	86	...	+	−	−	−	...	...	20
„ 13 ...	...	...	...	...	...	...	...	...	−	...	...	...	...	...	20
„ 16 ...	...	...	...	...	...	...	...	...	−	...	...	...	...	...	20
„ 17 ...	5,150,000	10,000	32	48	8	12	89	...	...	−	−	−	...	...	nil
„ 25 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	nil
„ 26 ...	5,000,000	6,000	14	60	8	18	85	...	...	−	−	−	...	...	...
„ 28 ...	...	...	26	33	16	25	...	...	...	...	...	...	...	...	...
„ 31 ...	...	...	...	...	...	...	...	...	−	...	...	...	...	...	...
August 3 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
„ 6 ...	...	...	...	...	...	...	...	...	−	−	−	−	...	...	...
„ 8 ...	...	...	34	61	3	2	...	...	−	...	−	−	...	...	...
„ 11 ...	...	...	53	30	6	11	...	...	...	...	...	+1	...	...	...
„ 14 ...	...	...	44	37	7	12	...	...	...	...	...	+4	...	...	...
„ 18 ...	...	...	46	34	5	15	...	...	...	...	...	−	...	...	...
„ 22 ...	...	...	44	28	6	22	...	...	...	...	...	−	...	...	...
„ 25 ...	...	...	...	...	...	...	...	...	...	...	...	−	...	...	...
„ 27 ...	...	...	...	...	...	...	...	...	−	...	...	...	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
„ 29 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
„ 31 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...
Sept. 3 ...	...	...	...	...	...	...	...	...	...	−	−	−	...	...	...

Date.	R.B.C.	W.B.C	Percentages.				H.B. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		As_2O_3 in mgs.
			P.N.	S.M.	L.M.	Eos.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.	
												Per cent.			
September 9 ...	...	...	...	...	...	...	...	...	...	...	–	–	...	...	...
„ 13 ...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 15 ...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 24 ...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 26 ...	...	...	...	...	...	...	...	...	...	–	–	–	...	...	...
„ 28 ...	5,300,000	11 600	33	48	10	9	96	...	...	+	–	–	...	...	...
„ 29 ...	...	...	...	...	...	...	...	...	..	+	–	–	...	...	...
„ 30 ...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
October 3 ...	...	...	...	...	...	...	...	...	...	+	–	+5	...	...	...
„ 7 ...	...	...	...	...	...	...	...	...	...	..	–	–	...	...	...
„ 10 ...	...	...	...	...	...	...	...	...	...	+	–	-	...	...	...
„ 17 ...	...	...	...	...	...	...	...	...	...	+	–	–	...	...	...
„ 21 ...	...	...	...	...	...	...	...	...	...	+	–	-	...	...	...
„ 28 ...	...	...	...	...	...	...	...	...	...	+	–	-	...	...	...
November 4 ...	...	...	...	...	...	...	...	...	...	–	..	–	...	...	...

Case 311. Namutide. Female. Age 20.

Entebbe.

July 13, 1904. The patient came complaining of headache and fever. She states that she has been sick for six months. There is general enlargement of the superficial lymphatic glands, especially the cervical. A lymphatic gland in the left posterior triangle was punctured and the juice examined. It was found to contain many active trypanosomes.

The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the amount of arsenic administered, the presence or absence of trypanosomes in the blood, lymphatic glands and cerebro-spinal fluid :—

Date. 1904.	R.B.C.	W.B.C.	Percentages.				Parasites in glands.		Parasites in blood.			Parasites in C.S.F.		Hb. per cent.	As_2O_3. mgs.
			P.N.	S.M.	L.M.	Eos.	Strept.	Tryp.	Fil.	Mal.	Tryp.	Strep.	Tryp.		
											Per cent.				
July 13	4,400,000	15,000	33	40	7	20	−	+	...	...	+	...	...	...	10
„ 14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15
„ 15	4,500,000	10,000	25	45	8	22	−	−	...	...	−	...	...	...	20
„ 16	...	...	...	...	...	...	...	−	...	...	...	...	...	...	20
„ 17	4,600,000	7,000	26	49	9	16	...	...	...	...	−	...	...	...	20
„ 19	4,400,000	6,870	33	42	7	18	...	−	...	...	−	...	...	...	20
„ 21	4,200,000	9,300	42	44	2	12	...	...	...	...	−	...	...	...	nil
„ 23	4,050,000	8,400	30	44	6	20	...	...	...	...	−	...	...	...	,
„ 26	4,000,000	8,700	11	64	6	19	...	−	...	...	−	...	...	...	„
„ 30	4,600,000	12,500	8	60	5	27	...	...	...	...	−	...	...	..	„
Aug. 4	4,350,000	7,500	11	75	2	12	...	...	...	...	+1	...	...	...	„
„ 6	...	...	31	44	12	13	...	...	...	...	+12	...	...	...	„
„ 8	4,800,000	6,250	16	59	6	19	...	−	...	...	−	...	...	...	„
„ 11	...	...	10	57	8	25	...	...	...	...	−	...	...	...	„
„ 14	...	...	...	...	...	...	...	...	...	...	−	...	...	...	„
„ 15	5,000,000	9,300	34	44	5	18	...	−	...	...	+25	...	...	...	„
„ 20	...	...	18	47	8	27	...	...	...	...	−	...	...	...	„
„ 23	5,100,000	30,000	33	36	3	28	...	...	...	...	−	...	...	...	„
„ 29	5,000,000	13,700	...	...	...	...	...	...	...	...	−	...	...	...	„

It will be seen from a consideration of the facts brought forward that the essential features of the condition called "trypanosoma fever" are also met with in sleeping sickness cases. In both polyadenitis is the most constant lesion met with, and the causal agent of this adenitis is in both the Trypanosoma gambiense. It is apparent from a study of the case of Jordien Murjan that the onset of this last stage of sleeping sickness synchronises with a marked development of the trypanosomes in the cerebro-spinal system. In following the after-history of cases of trypanosoma fever, we have arrived at the following conclusions:—1. That many of them terminate fatally as sleeping sickness cases, which may be regarded as the usual mode of termination. 2. That a certain number die of intercurrent affections, *e.g.*, pneumonia. 3. That a certain proportion remain well for long periods, indicating that a tolerance towards the parasite has been attained. It may be that some of these cases may become in time sufficiently immune to destroy the parasite. The evidence collected so far suggests that this is the case. The effect of arsenic on the trypanosoma in the blood of patients at this early stage of the disease has been observed.

The results of these observations are recorded in the histories of the five early cases. The action is somewhat remarkable. The parasites disappear first from the peripheral blood, and at a later date from the lymphatic glands. After an interval of varying length, the parasites will reappear in the blood temporarily, and then again disappear; but have not so far returned to the glands. Possibly the glands may store up the arsenic. From a consideration of the following table it will be seen that after the first destruction of the parasites in the glands and blood by the arsenic, they reappear in small numbers in the blood, and at a later period finally disappear. This suggests that arsenic acts in two ways. 1. By actually destroying the trypanosomes; and 2, the trypanosomes so destroyed actively immunise the individual, the effect of this not being apparent till later. Through the kindness of Geh. Med. Rath. Prof. Dr. P. Ehrlich in sending to one of us (Capt. Greig) 250 grams of trypanroth and tragaroth, we will be able to study their action in monkeys and man.

It will be observed on comparing the temperature charts and tables of the four cases of so-called "trypanosoma fever," that the entrance of the trypanosoma into the blood stream is marked by a rise of temperature. In the examination of the blood, a film was made from a drop obtained from the finger and stained by Leishman's method.

Table showing the effects of arsenic on Trypanosoma gambiense.

Name and Number of Case.	Month observations were made, 1904.	Trypanosomes in the lymph glands.		Trypanosomes in the blood.		Amount of arsenic administered as sod. arsenite.
		No. of observations.	Results.	No. of observations.	Results.	
Tenwa, 302	June	3	3+	4	2+ 2−	As nil.
	July	11	3+ 8−	9	1+ 8−	As 103 mgs.
	Aug.	...	...	11	2+ 9−	As 20 mgs.
	Sept.	...	...	8	8−	As nil.
	Oct.	...	...	6	6−	As nil.
Kitsame, 303	June	9	9+	23	16+ 7−	As 74 mgs.
	July	13	13−	15	2+ 13−	As 100 mgs.
	Aug.	...	...	12	3+ 9−	As nil.
	Sept.	...	...	9	2+ 7−	As nil.
	Oct.	...	...	6	6−	As nil.
Manawa, 304	June	1	1+	1	1−	As nil.
	July	8	4+ 4−	6	6−	As 105 mgs.
	Aug.	2	1+ 1−	11	3+ 8−	As nil.
	Sept.	1	1−	9	1+ 8−	As nil.
	Oct.	...	...	9	1+ 8−	As nil.
Mondu, 310	July	5	3+ 2−	4	1+ 3−	As 85 mgs.
	Aug.	3	3−	11	2+ 7−	As nil.
	Sept.	1	1−	9	9−	As nil.
	Oct.	...	...	6	1+ 5−	As nil.

As well as the cases above mentioned of trypanosoma fever, information has been got as to the after history of the men of the general population mentioned in the last Report in whose blood trypanosomes were found, but who, then, had no symptoms of sleeping sickness.

It has not been possible to trace out all these men owing to various causes, but the histories of a sufficient number have been obtained. Eighty natives were examined, and trypanosomes were found in the blood of twenty-three. Of these twenty-three, it has been ascertained that since that date, three have died of undoubted sleeping sickness, one ran away

from his shamba and was reported to have died of sleeping sickness. Two died from pneumonia (one was almost certainly in an early stage of sleeping sickness), five are now in an early stage of sleeping sickness.

No information has been obtained in six cases. The remainder (6) do not as yet present definite signs of sleeping sickness. These observations strongly support the contention that the so-called trypanosoma fever is an early stage of sleeping sickness. Further, that this phase of the disease may be short or very prolonged, the development of the last stage being dependent on an extension of the invasion of the lymphatic system to the lymph spaces of the nervous system. It will be of considerable interest to follow the further history of the six men showing still no signs.

The following table shows the results of the investigations into the after history of the men harbouring the trypanosomes in their blood:—

Table giving the after-history of men in whose blood trypanosomes were found in June, 1903.

No.	Name.	Age.	Sex.	District and Chief.	Date of Examination of Blood for Trypanosomes.	After-history.
1	Mucase	25	M.	Nkumba, Subugwao.	Present, June 13, 1903.	Died of sleeping sickness on December 13, 1903.
2	Saulo	18	„	Mugema ...	Present, June 26, 1903.	Died of sleeping sickness under care of French Fathers at Kisubi, December 2, 1903.
3	Gabula	20	„	Entebbe, Subugwao.	Present, June 22, 1903.	Became sick in his shamba. Was turned out by his friends, who stated he had sleeping sickness. Ran away and died in January, 1904, of sleeping sickness in Kyagwe.
4	Kululwe	40	„	Entebbe, Mugema.	Present, June 22, 1903.	He had gone to Buse, but was brought in by Subugwao. He showed on February 18, 1904, marked enlargement of lymphatic glands in both posterior triangles of neck, also in anterior. Pulse 108. Coarse tremors of hands. He is probably in an early stage of sleeping sickness. He is kept under observation.
5	Mugwanjamba ...	„	„	Kagagara ...	Present, June 8, 1903.	He ran away to Bulamwezi. Definite information has so far not been got, but is reported to have died of sleeping sickness.

6	Buza	30	„	Buse Island, Mugema.	Present, June 27, 1903.	Examined on December 30, 1903. Facial expression dull. Lumbar puncture performed, cerebro-spinal fluid contains no active trypanosomes. Patient was given ticket for future identification.
7	Kitungula	25	„	Semagale Island, Sese.	Present, June 16, 1903.	Mr. Savile reports, "He saw this man on May 4, 1900, and he is apparently well."
8	Tevamukopi... ...	35	„	Bunami Island, Sese.	Present, June 16, 1903.	Mr. Savile reports, "He saw this man in Sese, on May 4, 1904, and he is apparently well."
9	Tangamalala ...	25	„	Buse Island, Rasto.	Present, June 23, 1903.	Examined at Entebbe on December 30, 1903. He had no marked signs of sleeping sickness.
10	Wagononje	„	„	Sese Island ...	Present, June 12, 1903.	No information.
11	Sebolyamba... ...	„	„	„ ...	Present, June 13, 1903.	„ „
12	Gummia	40	„	„ ...	Present, June 16, 1903.	„ „
13	Zwaka	23	„	Kome Island ...	Present, June 13, 1903.	Rev. H. T. C. Weatherhead, July, 1904, writes, "that this man had left the island a short time ago and was suffering from sleeping sickness."
14	Nutaba	24	„	Bugaba Island...	Present, June 13, 1903.	No information.
15	Sebaganga	30	„	Buse Island ...	Present, June 19, 1903.	„ „

No.	Name.	Age.	Sex.	District and Chief.	Date of Examination of Blood for Trypanosomes.	After-history.
16	Nasagago	30	M.	Buse Island ...	Present, June 23, 1903.	No information.
17	Sabakaki	20	„	„ ...	Present, June 27, 1903.	He was examined at Entebbe on December 30, 1903. He did not present any marked signs of sleeping sickness.
18	Karala Barigi ...	30	„	Entebbe ...	Present, March 12, 1903.	Died on April 18, 1904, from pneumonia.
19	Kumsarsabba ...	25	„	„ ...	Present, March 28, 1903.	Under observation. General health is fairly good. Temperature irregular.
20	Jordien Murjan ...	35	„	„ ...	Present, March 31, 1903.	This man is now in an early stage of sleeping sickness. Trypanosomes in cerebro-spinal fluid.
21	Tabula*	25	„	„ ...	Present, April 15, 1904.	Health is still good and patient is able to continue at his work. Trypanosomes not yet present in cerebro-spinal fluid.
22	Bara Risgallah ...	35	„	„ ...	Present, April 21, 1904.	Died May 5, 1904, from pneumonia. Nervous system preserved for minute study.
23	J. M. (European) ...	...	„	„ ...	Present, April 2, 1903.	

* *Vide* footnote, p. 39.

9. *Are these trypanosomes pathogenic to animals, and can any specific difference be made out between them by animal experiment?*

The experiments on the various animals have been continued throughout the year. The additional observations and results obtained strengthen and support the conclusions arrived at in the last report.

The monkey is the most satisfactory animal for experimental inoculation. The continued observations show that the effect produced in them is in all respects similar, whether the trypanosoma infection is produced by blood from so-called "trypanosoma fever" cases or the cerebro-spinal fluid of undoubted sleeping sickness cases. As the question of the relationship of these two morbid conditions is an important one, full details of the experiments are given.

The other animals that we have employed for experimental inoculation are dogs, jackals, cats, rats, guinea-pigs, rabbits, oxen, goats, sheep and donkeys. None of these have shown any marked susceptibility to the disease, and some have remained resistant.

A. *Experiments on the effect on monkeys of the injections of cerebro-spinal fluid containing trypanosomes taken by lumbar puncture from cases of sleeping sickness.*

EXPERIMENT 2. MONKEY (MALE) (*Macacus Rhesus*).

March 23, 1903. Injected sediment of about 10 c.c. of cerebro-spinal fluid taken post-mortem from Case 18, Kapere.

May 11. Injected 2 c.c. cerebro-spinal fluid.

May 21. Trypanosomes are found in the blood to-day, 10 days after the second inoculation.

August 25. No marked symptoms up to the present.

November 28. Animal has been getting distinctly emaciated. He looks ill, but is able to rise.

The temperature curve remained about normal from March till August, 1903. From September, 1903, the evening temperature rose to about 103°, 105°, and fell in the morning to about 100°. The day before death, December 2, 1903, it fell to 94·8°.

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid :—

Date. 1903.	Parasites in blood.				Parasites in C.S.F.	
	Filar.	Malar.	Tryp.	Strept.	Tryp.	Strept.
April 9	...	−	−	...	...	...
„ 11	...	−	−	...	...	...
„ 23	−	−	−	...	...	...
„ 30	−	−	−	...	...	...
May 7	...	−	−	...	...	...
„ 14	...	−	−	...	...	...
„ 21	...	−	+	...	...	...
„ 28	...	−	+	...	...	...
June 4	...	−	+	...	...	...
„ 11	...		+	...	...	...
„ 18	...	−	+	...	...	...
„ 25	...	−	+	...	...	...
July 1	...	−	+	...	...	...
„ 23	...	−	+	...	...	...
„ 31	...	−	+	...	...	...
Aug. 7	...	−	+	...	...	...
„ 13	...	−	+	...	...	...
„ 20	...	−	+	...	...	...
„ 27	...	−	−	...	...	...
Sept. 4	...	−	−	...	...	...
„ 12	...	−	−	...	...	...
„ 25	...	−	−	...	...	...
Oct. 9	...	−	+	...	...	...
„ 22	...	−	−	...	...	...
Nov. 5	...	−	+	...	...	...
„ 19	...	−	−	...	...	...
„ 25	...	−	−	...	...	...
Dec. 3	...	−	+	...	−	...

December 3. Died. Post-mortem.

The body is rather emaciated, pupils equal and normal. Slight general enlargement of glands.

On opening the body there was some increase of pericardial fluid, no increase of fluid in pleural or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater some congestion of surface is seen—no distinct flattening; cerebro-spinal fluid not increased; examination of fluid does not show any active trypanosomes.

Heart.—Muscle is rather pale. Blood examined microscopically from this organ in stained preparation, some structures, probably altered trypanosomes, were seen.

Lungs.—Right somewhat congested, no consolidation; left healthy.

Liver, spleen and kidneys.—Nothing noteworthy.

Lymphatic glands.—Enlarged.

Remarks.—This animal has not shown such pronounced drowsy symptoms as some have, but it has become distinctly emaciated. Some time before its death it was much less lively, and took no notice of people, and did not come forward readily for its food. The post-mortem showed nothing to account for death apart from the trypanosomes.

EXPERIMENT 34. MONKEY (MALE) (*Macacus Rhesus*).

To note the effect of injecting the cerebro-spinal fluid from a case of sleeping sickness into the vertebral canal of a monkey.

April 8, 1903. Injected 1 c.c. of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into the spinal canal of this monkey.

April 30. Trypanosomes appeared in the blood to-day, 19 days after inoculation into the spinal canal. Note that the temperature curve shows no sign of this invasion.

May 2. Trypanosomes numerous in the blood. Temperature taken and found to be 106·4° F.

August 25. This monkey is beginning to show the usual symptoms of the disease in the monkey. He sits most of the day with his head fallen on his chest, evidently asleep, and his temperature has become very irregular.

The temperature remained normal till May 20, 1903. From that date it showed an evening rise averaging 103°–104°. From August, 1903, the temperature remained sub-normal, falling to 94·2 on September 7, 1903, the day of its death.

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid:—

Date. 1903.	R.B.C.	W.B.C.	S.M.	L.M.	P.	Parasites in blood.				Parasites in C.S.F.	
						Filar.	Mal.	Tryp.	Strep.	Tryp.	Strep.
April 11	6,100,000	8,991	71	3	26	–	–	–	...	...	...
„ 24	...	...	...	...	...	–	–	–	...	...	...
„ 30	...	...	...	...	...	–	–	+	...	...	...
May 7	...	...	...	...	...	...	–	+	...	...	...
„ 14	...	...	...	...	...	...	–	+	...	...	...
„ 21	...	...	...	...	...	...	–	+ +	...	...	...
„ 27	...	...	...	...	...	...	–	+	...	...	...
June 4	...	...	...	...	...	...	–	+	...	...	...
„ 11	...	...	...	...	...	...	–	+	...	...	...
„ 18	...	...	...	...	...	...	–	+	...	...	...
„ 25	...	...	...	...	...	...	–	+	...	...	...
July 1	...	...	...	...	...	...	–	+	...	...	...
„ 23	...	...	...	...	...	...	–	+	...	...	...
„ 31	...	...	...	...	...	...	–	+	...	...	...
Aug. 13	...	...	...	...	...	...	–	+	...	...	...
„ 20	...	...	...	...	...	...	–	+	...	...	...
„ 27	...	...	...	...	...	...	–	–	...	...	...
Sept. 4	...	...	...	...	...	...	–	+	...	...	...
„ 7	...	...	...	...	...	...	–	+	...	+	...

September 7. Has continued in the same condition since last note. He was in a dying state this morning. Killed by chloroform.

Post-mortem immediately after death.

The body is emaciated, coat very rough.

Brain.—On removing the calvarium and reflecting the dura mater some opacity of the membranes is seen, some flattening of the convolutions and slight adhesions at base of brain.

Fluid from the third ventricle was examined and active trypanosomes were seen. There was some blood in the fluid.

Heart.—Normal; blood taken from that organ showed the presence of trypanosomes.

Lungs.—A few pigmented areas, otherwise nothing noteworthy.

Liver.—Appears to be fatty.

Spleen.—Nothing noteworthy.

Kidneys.—Apparently healthy.

Lymphatic glands in mesentery and retroperitoneal regions were enlarged. Also those in inguinal region and left axilla.

Remarks.—This animal towards the end showed very characteristically the usual features of the disease met with in monkeys. The post-mortem appearances were also pretty typical of an ordinary sleeping sickness case. The trypanosomes were found living in the cerebro-spinal fluid.

Experiment 95. Monkey (*Cercopithecus sp.*).

To note the effect of injecting the cerebro-spinal fluid from a case of sleeping sickness into the vertebral canal of a monkey.

May 13, 1903. Blood examined; there were no malarial parasites or trypanosomes present.

May 14. Injected 1 c.c. of cerebro-spinal fluid from a case of sleeping sickness into the vertebral canal of this monkey.

August 26. About 8.30 a.m. monkey had a convulsive seizure affecting the left side of its body. It lay on the ground for about an hour. Monkey appears rather crouched up.

August 29. Animal died this morning.

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid :—

Date. 1903.	Parasites in Blood.				Parasites in C.S.F.	
	Filar.	Mal.	Tryp.	Strep.	Tryp.	Strep.
May 13	...	−	−	...	...	...
„ 22	...	−	−	...	...	...
„ 29	...	−	−	...	...	...
June 4	...	−	+	...	...	...
„ 11	...	−	−	...	...	...
„ 20	...	−	+	...	...	...
„ 25	...	−	+	...	...	...
July 1	...	−	+	...	...	...
„ 23	...	−	−	...	...	...
„ 31	...	−	+	...	...	...
Aug. 13	...	−	+	...	...	...
„ 21	...	−	+	...	...	...
„ 28	...	−	−	...	...	...
„ 29	...	−	−	...	−	...

Post-mortem examination.

On removing the calvarium and reflecting the dura mater the convolutions were seen to be somewhat flattened. There was no marked congestion. The cerebro-spinal fluid was examined microscopically, but no living trypanosomes could be found.

Heart.—Nothing noteworthy—blood from this organ examined microscopically did not show the presence of trypanosomes.

Lungs.—Both showed the presence of infarctions.

Spleen.—Congested and somewhat enlarged.

Liver.—Nothing noteworthy.

Kidneys.—Both apparently healthy.

Remarks.—In this case the animal had a very definite involvement of the nervous system shortly before its death; probably due to interference with the cerebral circulation by the parasite. This condition no doubt caused the death of the animal. The absence of the parasites from the peripheral circulation just before death coinciding with the nervous seizure suggested their having lodged in the nervous system.

Experiment 96. Monkey (*Cercopithecus sp.*).

To note the effect of injecting the cerebro-spinal fluid from a case of sleeping sickness into the vertebral canal of a monkey.

May 14, 1903. Blood examined—no malaria or trypanosomes.

Injected 1 c.c. of cerebro-spinal fluid from a case of sleeping sickness into the vertebral canal of this monkey.

August 25. No symptoms. No rise of temperature.

The following table shows the presence or absence of trypanosomes in the blood :—

Date. 1903.	Parasites in Blood.				Parasites in C.S.F.	
	Filar.	Mal.	Tryp.	Strep.	Tryp.	Strep.
May 14	...	+	−	...	...	...
„ 22	...	+	−	...	...	...
„ 29	...	+	-	...	...	...
June 4	...	+	−	...	...	...
„ 11	...	+	−	...	...	...
„ 20	...	+	−	...	...	...

June 24. Again injected 1 c.c. of cerebro-spinal fluid from a case of sleeping sickness into the spinal canal of this monkey.

October 29. Injected 5 c.c. of cerebro-spinal fluid from a case of sleeping sickness under the skin of this monkey.

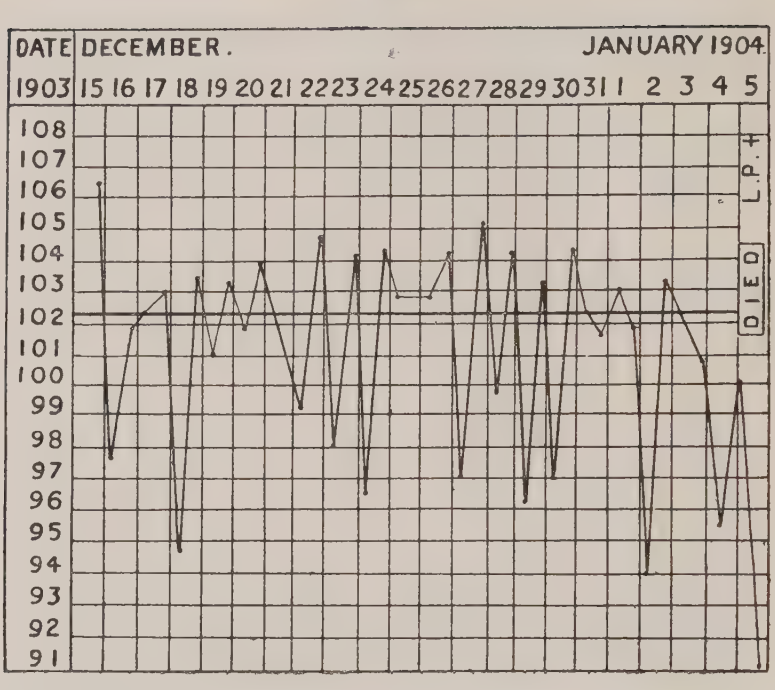
December 15. This monkey is getting thinner and is not so active, tending to sit crouched up. He is out of condition.

December 26. His attitude is now very characteristic. His head is drooping between his knees. He seldom raises his head, and if he does so it immediately falls again. He is unable to climb into his box without help.

January 1, 1904. Animal is very ill. Saliva is dribbling out of his mouth, and there appears to be some paresis of the muscles about his mouth.

January 5. He is now lying on his back. Breathing very shallow. Conjunctival reflex still present. Passing his motions under him. Closely resembles a case of sleeping sickness. Performed lumbar puncture; drew off 1 c.c. cerebro-spinal fluid. Microscopically shows some red and white cells and active trypanosomes.

The following chart represents the temperature curve. The observations were begun as soon as the animal was observed to be ill :—



The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid:—

Date.	Parasites in blood.				Parasites in C.S.F.	
	Filar.	Malar.	Tryp.	Strept.	Tryp.	Strept.
1903.						
July 1	...	+	−	...	...	...
„ 23	...	+	−	...	...	...
„ 31	...	+	+	...	...	...
Aug. 13	...	+	+	...	...	...
„ 21	...	+	+	...	...	...
„ 27	...	+	+	...	...	...
Sept. 4	...	+	−	...	...	...
„ 12	...	+	+	...	...	...
„ 25	...	+	−	...	...	...
Oct. 8	...	+	−	...	...	...
„ 22	...	+	−	...	...	...
Nov. 5	...	+	−	...	...	...
„ 19	...	+	+	...	...	...
Dec. 3	...	+	−	...	...	...
„ 18	...	+	+	...	...	...
„ 26	...	+	+	...	...	...
1904.	...					
Jan. 1	...	+	+	...	...	...
„ 5	...	+	+	...	+	...

January 5, died 12.30 p.m.

Post-mortem immediately after death.

The body is profoundly emaciated—sore over lumbar region; pupils are equal and normal. The inguinal, axillary and cervical glands are enlarged.

On opening the body there is some increase of fluid in the pericardial cavity.

No fluid in pleural or peritoneal cavities.

Heart.—Some jelly-like material round base. Petechiæ are seen on the papillæ under endocardium of left ventricle. Muscle is pale. Blood taken from it and examined microscopically shows many living trypanosomes, and some appear vacuolated.

Lungs.—Are both healthy.

Liver.—Nothing noteworthy.

Spleen.—Is enlarged, dark in colour.

Kidneys.—Right shows two areas of infarction. Left nothing noteworthy.

Intestines.—Appear healthy.

Lymphatic glands of omentum and along the aorta and pelvic vessels are enlarged and congested.

Brain.—On removing the calvarium there was some increase of cerebro-spinal fluid. The convolutions were congested and showed slight flattening. The brain and spinal cord were preserved for future examination.

Remarks.—This animal towards the close of his life developed a condition which represented very perfectly the signs met with in an ordinary case of sleeping sickness. The trypanosomes were present and active in the cerebro-spinal fluid before death. His attitude during life was exactly similar to that shown in photograph of Experiment 60. Report IV.

Experiment 54. Monkey (*Cercopithecus sp.*).

To note the effect of injection of cerebro-spinal fluid containing trypanosomes, from a case of sleeping sickness, into the brain cavity of a monkey.

April 9, 1903. Injected 1 c.c. of cerebro-spinal fluid from a case of sleeping sickness into the brain cavity of this monkey through the foramen magnum.

August 25. No symptoms of sleeping sickness noted.

November 16. Injected 5 c.c. of cerebro-spinal fluid from a case of sleeping sickness subcutaneously.

December 15. Animal is seedy and not so active as before.

January 1, 1904. Monkey is getting thin. Facial expression is dulled.

January 24. Animal is tending to crouch and his attitude at times is very characteristic. Face is puffy.

January 25. Monkey is lying on the ground. Limbs appear partially paralysed. He can be roused. Breathing is shallow. Saliva is dribbling from his mouth.

The temperature remained normal till May 9, 1903. Up to December, 1903, the temperature was not recorded as the animal showed no signs of sickness. From December, 1903, it showed an evening rise averaging two or three degrees. On January 25, 1904 (the day of its death) it fell to 99°.

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid :—

Date.	Parasites in blood.				Parasites in C.S.F.	
	Fil.	Mal.	Tryp.	Strept.	Tryp.	Strept.
1903.						
April 11 ...	...	−	−	−	...	...
„ 23 ...	−	−	−	...	...	...
„ 30 ...	−	−	+	...	...	...
May 7 ...	...	−	+	...	...	...
„ 14 ...	...	−	+	...	...	...
„ 21 ...	...	-	+	...	...	...
„ 28 ...	...	−	+	...	...	...
June 4 ...	...	−	−	...	...	...
„ 11 ...	...	−	+	...	...	...
„ 18 ...	...	−	+	...	...	...
„ 25 ...	...	+	+	...	...	...
July 1 ...	...	−	+	...	...	...
„ 23 ...	...	−	+	...	...	...
„ 31 ...	...	−	+	...	...	...
August 13 ...	...	-	−	...	...	...
„ 20 ...	...	−	+	...	...	...
„ 27 ...	...	−	−	...	...	...
Sept. 4 ...	...	−	−	...	...	...
, 12 ...	...	−	+	...	...	...
„ 25 ...	...	−	−	...	...	...
October 8 ...	...	−	−	...	...	...
„ 22 ...	...	−	−	...	...	...
Nov. 5 ...	...	−	−	...	...	...
„ 19 ...	...	−	−	...	...	...
Dec. 3 ...	...	−	−	...	...	...
„ 18 ...	...	−	−	...	...	...
1904.						
January 1 ...	...	−	+	...	...	...
„ 9 ...	...	−	+	...	...	...
„ 15 ...	...	−	−	...	...	...
„ 20 ...	...	−	−	...	...	...
„ 23 ...	...	−	−	...	...	...
„ 25 ...	...	−	+	...	−	...

January 25, 1904. Died at 5 p.m. Post-mortem at once.

The body is not much emaciated. Pupils are equal and normal. Glands show slight general enlargement. There is some increase of fluid in pericardial cavity, no increase in pleural or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater, which was adherent in the frontal region on both sides, the convolutions were seen to be congested and showed slight

flattening. Brain was removed entire for minute examination, cerebro-spinal fluid examined microscopically did not show the presence of active trypanosomes.

Heart.—Some jelly-like material round base, otherwise nothing noteworthy. Blood from this organ examined microscopically did not show fully formed trypanosomes, but some bodies which were apparently broken down trypanosomes.

Lungs.—Both healthy.

Liver.—Slightly enlarged and congested.

Spleen.—Somewhat enlarged and firm on section.

Kidneys.—Both normal.

Lymph glands of mesentery and also along the side of great vessels are enlarged and congested.

Remarks.—In this animal the first apparent sign was a peculiar alteration of facial expression, the face was dull, puffy and wanting in brightness—a similar condition to that met with in sleeping sickness cases. He also tended to crouch up at the same time and finally assumed the usual characteristic attitude. A peculiar fact was that the trypanosomes which had been absent from the peripheral blood for a long period reappeared just before death.

There was no other cause discovered at the post-mortem to account for the animal's death apart from the trypanosomes.

Experiment 309. Monkey (*Cercopithecus sp.*).

To note the effect of subcutaneous injection of gland juice from a case of sleeping sickness into a monkey.

June 30, 1904. Injected subcutaneously 0·5 c.c. of emulsion of cervical lymph gland from case of sleeping sickness into a monkey.

July 15. Trypanosomes present in the blood to-day, the fifteenth day after inoculation.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.				Parasites in blood.		
				Fil.	Mal.	Tryp.
	1904.					
July	2	...	...	...	−	−
„	15	...	...	...	−	+
„	22	...	...	...	−	+
„	30	...	...	...	−	+
August	5	...	...	...	−	+
„	12	...	...	...	−	+
„	26	...	...	...	−	+
Sept.	2	...	...	...	−	+
„	9	...	...	...	−	+

Date.	Parasites in blood.		
	Fil.	Mal.	Tryp.
Sept. 15	...	−	+
„ 23	...	−	+
„ 30	...	−	+
October 7	...	−	−
„ 14	...	−	+
„ 21	...	−	+
Nov. 4	...	−	+

Remarks.—This experiment is given to show that the gland juice as well as the cerebro-spinal fluid and blood of sleeping sickness cases when injected into a monkey can produce trypanosoma infection.

B. *Experiments on the Effect of the Injection into Monkeys of Blood containing Trypanosomes from Cases showing no Symptoms of Sleeping Sickness.*

Experiment 6. Monkey (*Cercopithecus sp.*).

To note effect of injection of blood from Case 63, Kumsarsaba.

March 28, 1903. Injected 4 c.c. blood from Dr. Baker's case, Kumsasaba, a policeman whose blood contained trypanosomes yesterday.

August 15. No symptoms.

January 28, 1904. Facial expression of this monkey is somewhat altered, being dull and heavy.

April 10. Removed 5 c.c. blood, also two enlarged glands from right femoral region. No active trypanosomes in the lymphatic juice.

April 18. Animal is very sick and is lying on the ground.

The temperature remained normal till August, 1903. From September, 1903, it showed a distinct evening rise of one or two degrees until the day of its death on April 18, 1904.

The following table shows the presence or absence of trypanosomes in the blood, lymphatic glands and cerebro-spinal fluid :—

Date.	Parasites in lymph glands.		Parasites in blood.				Parasites in C.S.F.	
	Tryp.	Strept.	Filar.	Malar.	Tryp.	Strept.	Tryp.	Strept.
1903.								
April 9 ...	...	...	...	...	+	−	...	...	...
„ 11 ...	...	...	...	...	+	−	...	...	...
„ 23 ...	...	...	...	−	+	−	...	...	...
„ 30 ...	...	...	...	−	+	−	...	...	...
May 7 ...	...	...	...	...	+	+	...	...	...
„ 14 ...	...	...	...	...	+	+	...	...	...
„ 21 ...	...	...	...	...	+	+	...	...	...
„ 28 ...	...	...	...	...	+	+	...	...	...
June 4 ...	...	...	...	...	+	+	...	...	...
„ 11 ...	...	...	...	...	+	−	...	...	...
„ 18 ...	...	...	...	...	+	−	...	...	...
„ 25 ...	...	...	...	...	−	+	...	...	...
July 1 ...	...	...	...	...	+	+	...	...	...
„ 23 ...	...	...	...	...	+	+	...	...	...
„ 31 ...	...	...	...	...	+	−	...	...	...
Aug. 7 ...	...	...	...	...	+	+	...	...	...
„ 13 ...	...	...	...	...	+	−	...	...	...
„ 20 ...	...	...	...	...	+	+	...	...	...
„ 27 ...	...	...	...	...	+	−	...	...	...
Sept. 4 ...	...	...	...	...	+	+	...	...	...
„ 12 ...	...	...	...	...	+	+	...	...	...
„ 25 ...	...	...	...	...	+	−	...	...	...
Oct. 8 ...	...	...	...	...	−	+	...	...	...
„ 22 ...	...	...	...	...	+	+	...	...	...
Nov. 5 ...	...	...	...	...	+	−	...	...	...
„ 19 ...	...	...	...	...	+	−	...	...	...
„ 25 ...	...	...	...	...	+	+	...	...	...
Dec. 3 ...	...	...	...	...	+	−	...	...	...
„ 18 ...	...	...	...	...	+	+	...	...	...
„ 31 ...	...	...	...	...	+	−	...	...	...
1904.									
Jan. 9 ...	...	...	...	...	+	+	...	...	...
„ 15 ...	...	...	...	...	+	+	...	...	...
„ 28 ...	...	...	...	...	+	+	...	...	...
Feb. 6 ...	...	...	...	...	+	+	...	...	...
„ 21 ...	...	...	...	...	+	+	...	...	...
„ 28 ...	...	...	...	...	+	+	...	...	...
March 6 ...	...	...	...	...	+	+	...	...	...
„ 13 ...	...	...	...	...	+	+	...	...	...
„ 20 ...	...	...	...	...	+	+	...	...	...
„ 28 ...	...	...	...	...	+	+	...	...	...
April 10 ...	...	−	−	...	+	+	...	...	...
„ 19 ...	...	...	...	...	+	+	...	−	...

April 19. Died in the night. Post-mortem.

The body is not emaciated. Wound in right femoral region practically healed and quite healthy. Superficial glands are generally enlarged and somewhat congested.

On opening the body there is no increase of pericardial or pleural fluid, in the peritoneum there is some exudation of lymph surrounding the rectum and lower part of sigmoid flexure

of colon, this is firmly adherent to the bowel and is probably a few weeks old.

Brain.—On removing the calvarium and reflecting the dura mater the surface of the brain is pale, but shows nothing noteworthy to the naked eye. Spinal cord removed with roots and ganglion. Brain and spinal cord reserved for minute examination.

Heart.—Nothing noteworthy.

Lungs.—Both are somewhat congested.

Liver.—Apparently healthy.

Kidneys.—Nothing noteworthy.

Spleen.—Slightly enlarged.

Lymphatic glands.—Enlarged along aorta and iliac vessels.

Remarks.—Clearly in this experiment the course of the disease was interrupted by an intercurrent condition, the local peritonitis, which was undoubtedly occasioned by traumatism whilst introducing the thermometer into the rectum, assisted by the anæmia occasioned by the removal of 5 c.c. of blood, brought about prematurely the fatal issue. It is interesting to note the long duration of the disease in monkeys.

EXPERIMENT 58. MONKEY, BLACK-FACED VARIETY (*Cercopithecus sp.*).

April 21, 1903. Injected subcutaneously 3 c.c. of blood, containing trypanosomes from Case 68, Bara Risgallah.

April 30. Trypanosomes appeared in the blood to-day for the first time, nine days after injection.

August 20. Up to the present this monkey has shown no signs of being ill.

December 2. For the last few days animal has been very quiet and its head is constantly nodding. The grass has been allowed to grow round the foot of his box, indicating that for some time past he has been out of health.

December 3. Animal has now assumed a very characteristic attitude, crouching on the ground with his head between his knees—a typical picture of sleeping sickness as depicted in Experiment 60, Report IV.

December 6. Animal is now lying on his side unable to rise. He is in a lethargic condition, apparently dying. Lumbar puncture at 2 p.m., a few drops of clear fluid obtained—showed under the microscope a few red cells and active trypanosomes. Breathing regular. Hearts sounds very weak. Died at 5 p.m.

The temperature shortly before death fell considerably below normal.

The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid :—

Date.	Parasites in blood.				Parasites in C.S.F.	
	Filar.	Malar.	Tryp.	Strep.	Tryp.	Strepto.
1903.						
April 14	...	+	−	...	...	...
„ 30	...	+	+	...	...	...
May 7	...	+	+	...	...	...
„ 14	...	+	+	...	...	...
„ 21	...	+	+	...	...	...
„ 28	...	+	+	...	...	...
June 4	...	+	+	...	...	...
„ 11	...	...	...	...	...	...
„ 18	...	−	+	...	...	...
„ 25	...	−	+	...	...	...
July 1	...	−	+	...	...	...
„ 23	...	+	+	...	...	...
„ 31	...	+	+	...	...	...
Aug. 13	...	−	+	...	...	...
„ 20	...	−	+	...	...	...
„ 27	...	−	+	...	...	...
Sept. 4	...	−	+	...	...	...
„ 12	...	−	+	...	...	...
„ 25	...	+	+	...	...	...
Oct. 8	...	−	+	...	...	...
„ 22	...	−	+	...	...	...
Nov. 5	...	+	−	...	...	...
„ 19	...	−	−	...	...	...
Dec. 3	...	−	+	...	...	...
„ 6	...	+	+	...	+	...

Post-mortem examination after one hour.

External appearances.—Animal is not emaciated. Slight general enlargement of lymphatic glands. Pupils normal.

Chest.—No increase of pericardial or pleural fluid.

Heart.—Some jelly-like material round the base, otherwise normal.

Lungs.—Nothing noteworthy,

Abdomen.—No increase of peritoneal fluid.

Liver, spleen, and kidneys.—Are all healthy.

Lymphatic glands in mesentery are enlarged.

Brain.—The surface is somewhat dry, with slight flattening of the convolutions and no increase of cerebro-spinal fluid. Brain removed entire for minute investigation. Spinal cord shows naked eye nothing noteworthy; kept for microscopic examination. Smears of heart's blood show the presence of trypanosomes; they are few in number and peculiarly altered, being very like those depicted in Experiment 60. Malaria is also present.

Remarks.—This experiment is a most important one, as affording proof of the identity of the trypanosoma of sleeping sickness and that found in men in their lymphatic glands and blood. Towards the end the animal presented a picture of a sleeping sickness case in its last stages; the mode of death being also similar, viz., lying in a state of torpor with sub-normal tempera-

ture. The presence of trypanosomes in the cerebro-spinal fluid obtained by lumbar puncture was very suggestive. The long duration of the experiment also brings it closely into line with the condition found in sleeping sickness, and this condition was produced by a single injection of blood from Experiment 68, Bara Risgallah. There was no other cause to account for the animal's death apart from the trypanosomes.

EXPERIMENT 123. MONKEY (*Cercopithecus sp.*).

To note the effect of blood containing trypanosomes from Case 64, Jordien Murjan.

May 25, 1903. Examined blood. No trypanosomes present. Injected 1 c.c. of blood from Case 64, Jordien Murjan, into the brain of this monkey.

November 9. Injected under the skin 10 c.c. blood from Jordien Murjan.

December 31. Animal appears seedy. He tends to crouch and is not taking his food.

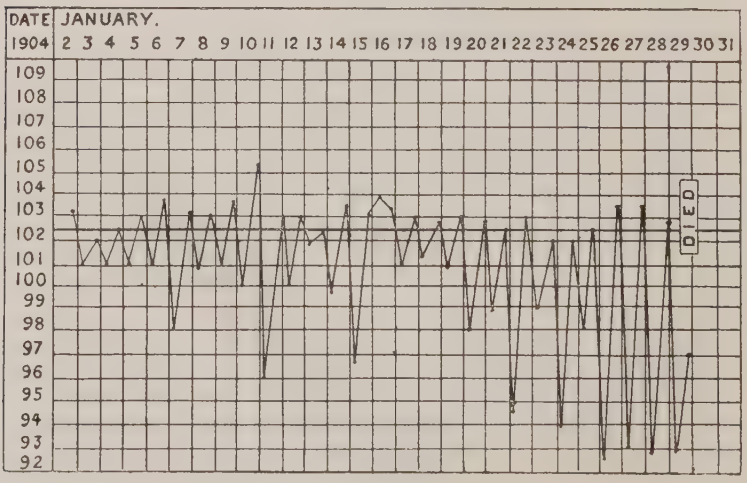
January 9, 1904. Drew off 2 c.c. cerebro-spinal fluid by lumbar puncture but found no living trypanosomes in it.

January 22. Condition is quite typical of sleeping sickness met with in monkeys. He is very thin.

January 24. Somewhat peculiarly altered trypanosomes seen in the blood.

January 29. Animal very sick to-day. Attitude quite typical. General tremors of his body. Eyes are shut as if asleep. He can be roused, but his head immediately droops between his legs and his eyes shut. Has a very drowsy look. 4 c.c. cerebro-spinal fluid removed by lumbar puncture; no active trypanosomes seen.

The following chart shows the temperature curve :—



The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid:—

Date.	Parasites in blood.			Parasites in C.S.F.	
	Filar.	Mal.	Tryp.	Tryp.	Strept.
1903.					
May 25	...	−	−	...	...
„ 28	...	+	−	...	...
June 4	...	+	−	...	...
„ 11	...	+	+	...	...
„ 20	...	+	+	...	...
July 1	...	+	+	...	...
„ 23	...	+	+	...	...
„ 31	...	+	+	...	...
Aug. 13	...	−	+	...	...
„ 21	...	+	+	...	...
„ 28	...	+	+	...	...
Sept. 4	...	+	+	...	...
„ 12	...	+	+	...	...
„ 25	...	+	−	...	...
Oct. 8	...	+	−	...	...
„ 22	...	+	−	...	...
Nov. 5	...	+	−	...	...
„ 19	...	+	−	...	...
Dec. 3	...	+	−	...	...
„ 13	...	+	−	...	...
„ 18	...	−	−	...	...
„ 31	...	−	−	...	...
1904.					
Jan. 9	...	−	−	−	...
„ 15	...	−	−	...	...
„ 24	...	−	+	...	...
„ 27	...	−	−	...	...
„ 29	...	−	−	...	...

January 29. Died at 6 p.m. Post-mortem at once.

The body was profoundly emaciated. Glands show slight general enlargement. Pupils equal and normal. No sores. No increase of fluid in pericardial or pleural cavities, slight increase in peritoneal cavity.

Brain.—On removing the calvarium and reflecting the dura mater the superficial vessels are seen to be congested. Slight flattening of the convolutions, some increase of sub-arachnoid fluid. Examination of cerebro-spinal fluid on day of death showed no living trypanosomes. Brain removed entire for minute investigation.

Heart.—No noteworthy change. Blood removed from it showed no trypanosomes.

Lungs.—Both healthy.

Liver.—Healthy.

Spleen.—Nothing noteworthy.

Kidneys.—Both normal.

Glands.—Enlarged in mesentery—some are congested.

Remarks.—Towards the end this monkey presented a most striking clinical picture of a sleeping sickness case. The attitude, the general tremors of the body, the swinging temperature, were all very marked. The blood with which this animal was injected was obtained from a case which is, now, in the earliest stage of sleeping sickness. The trypanosomes were at one time very numerous in the blood; after being absent on several occasions they reappeared in the blood and were scanty and somewhat altered. The lymphatic glands were not examined intra vitam or post-mortem. Had they been examined it is possible living trypanosomes would have been found.

There is no doubt this animal died from trypanosoma infection, as there was nothing else to account for death. A similar disappearance of the trypanosomes from the peripheral blood was met with in the animal varieties; compare Experiment 179 (mule) and Experiment 152 (Pordage's ox).

Experiments on the Effect of the Injection of these Trypanosomes into Dogs.

As stated in the Further Report, the native dog of Uganda is not satisfactory as an experimental animal. The majority die of anchylostomiasis before the experiment is finished.

The pup appears to be distinctly less susceptible than the adult. Both of the pups became infected by piroplasma canis, which also occurred amongst other dogs in Entebbe. It is probably conveyed by means of a tick. This parasite was further studied. A jackal was also inoculated with blood containing Trypanosoma gambiense. The course of the disease was similar to that in the adult dog. Its susceptibility is not so great as the monkey, but greater than the goat. This gradation of susceptibility is also seen amongst men: in the table giving the after-history of the cases in which trypanosomes were present in the blood only a year ago, it will be observed that some cases rapidly passed into the sleeping sickness stage and died, others took much longer and some appeared quite well about a year later. It is possible that some of these are refractory.

Experiment 144. Brindled Pup.

To note effect of subcutaneous injection of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into a pup.

June 23, 1903. Injected 4 c.c. cerebro-spinal fluid containing trypanosomes into this pup.

September 1. Again injected 4 c.c. cerebro-spinal fluid from case of sleeping sickness.

September 7. Injected 4 c.c. of cerebro-spinal fluid from case of sleeping sickness.

September 14. Injected 8 c.c. of cerebro-spinal fluid from case of sleeping sickness.

September 29. Blood examined and pyrosoma canis was observed to be present.

October 1. Blood very pale. At 4 p.m. animal passed a little urine; examined spectroscopically showed the presence of hæmoglobin.

The temperature fell to 101° on October 1, 1903.

The following table shows the number of red cells, the percentage of hæmoglobin and the presence or absence of pyrosomes and trypanosomes in the blood:—

Date.	R.B.C.	Hb. per cent.	Parasites in the blood.			
			Filar.	Malar.	Pyro.	Tryp.
1903.						
June 30	...	...	...	...	...	–
July 17	...	...	...	...	...	–
„ 21	...	...	...	...	...	–
„ 28	...	...	...	...	...	–
Aug. 4	...	...	...	...	...	–
„ 14	...	...	...	...	...	–
„ 18	...	...	...	...	...	–
„ 25	...	...	...	...	...	–
Sept. 1	...	...	...	...	...	–
„ 8	...	...	...	...	...	–
„ 22	...	...	...	...	...	–
„ 29	...	...	...	...	+	–
Oct. 1	1,600,000	15	...	...	+	–

October 3. Post-mortem.

The body is fairly well nourished. Superficial glands not enlarged. On opening the body there is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Appears to be normal.

Lungs.—Both show minute embolic areas.

Liver.—Somewhat enlarged and apparently fatty.

Spleen.—Considerably enlarged, measures 7 inches by 2 inches.

Kidneys.—Both distinctly congested, especially the cortex and surface.

Bladder.—Contained some reddish brown urine.

Remarks.—In this experiment, although repeated injections of cerebro-spinal fluid were made, the animal remained completely refractory. In this animal the pyrosoma canis developed, and gave rise to all the usual signs of this disease as met with in dogs.

Experiment 146. Black Pup.

June 23, 1903. Injected subcutaneously 4 c.c. of blood from Case 64, Jordien Murjan, into this dog.

September 21. Again injected 5 c.c. of blood from Case 64, Jordien Murjan.

September 26. Pyrosoma canis observed in the blood. Blood is very pale and watery.

October 13. Dog is out of condition—no dark urine noted.

November 3. Has been lying about lately, during night he passed smoky urine. This showed a hæmoglobin band on spectroscopic examination. Considerable quantity of albumen present.

The temperature remained about normal until November 5, 1903 (the day of death), when it fell to 93·2.

The following table shows the presence or absence of pyrosomes and trypanosomes in the blood:—

Date.	Parasites in the blood.			
	Filar.	Malar.	Pyrosoma.	Tryp.
1903.				
June 30...	...	...	...	–
July 17...	...	...	...	–
„ 21...	...	...	...	–
„ 28...	...	...	...	–
Aug. 4...	...	...	...	–
„ 14...	...	...	...	–
„ 18...	...	...	...	–
„ 25...	...	...	...	–
Sept. 1...	...	...	...	–
„ 8...	...	...	...	–
„ 15...	...	...	...	–
„ 22...	...	...	...	–
„ 29...	...	...	+	–
Oct. 1...	...	...	+	–
„ 2...	...	...	+	–
„ 4...	...	...	+	–
„ 6...	...	...	+	–
„ 7...	...	...	+	–
„ 8...	...	...	+	–
„ 12...	...	...	+	–
„ 26...	...	...	+	–
Nov. 3...	...	...	+	–

November 5. Post-mortem.

The body is fairly well nourished. No enlargement of superficial glands. No increase of fluid in pericardial, pleural or peritoneal cavities.

Heart.—Nothing noteworthy.

Lungs.—Both show areas of embolism. Examination of these microscopically shows many red cells infected with pyrosomes.

Liver.—Congested.

Spleen.—Distinctly enlarged, measures 10 inches by $2\frac{1}{2}$ inches. Microscopically shows corpuscles infected with pyrosomes.

Kidneys.—Naked eye show nothing noteworthy. Capsule strip readily.

Bladder.—Contains urine which on examination shows the presence of blood.

Remarks.—This experiment shows that the young dog is absolutely refractory to the Trypanosoma gambiense, although the experiment lasted nearly 5 months. It was of interest further, in that the pyrosoma canis developed in it. This was one of a number of animals in Uganda in whom this parasite was discovered. Some inoculations were made to determine the effects on different animals of this parasite.

Experiment 151. Jackal.

To note the effects of subcutaneous injection of blood from a man not showing signs of sleeping sickness into a jackal.

July 24, 1903. Injected subcutaneously 4 c.c. blood from Case 31, Karala Barigi.

November 2. This animal killed and almost entirely consumed a monkey, Experiment 232, in whose blood trypanosomes of the animal variety were abundantly present.

November 3. Blood of animal contains many trypanosomes.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
July 24	...	...	−
Aug. 4	...	...	+
„ 18	...	...	+
„ 25	...	...	−
Sept. 1	...	...	+
„ 8	...	...	−
„ 22	...	...	+
„ 29	...	...	−
Oct. 13	...	...	−
„ 27	...	...	−
Nov. 3	...	...	+

Remarks.—This experiment shows that the effects produced in an adult jackal by the Trypanosoma gambiense are practically the same as in the adult dog. The animal is only partially susceptible. The invasion of the other trypanosoma following

the eating of the monkey was undoubtedly, due to the animal having punctured itself with the bones, and in this way became infected with a variety of trypanosoma to which it is susceptible.

Experiment 198. Cat (full grown).

To note the effect of subcutaneous injection of blood from a case of trypanosoma fever into a cat.

September 23, 1903. Injected subcutaneously to-day 10 c.c. of blood from case of trypanosoma fever, Karala Barigi.

November 11, 1903. Again injected 8 c.c. of blood from case of trypanosoma fever, Karala Barigi.

January 19, 1904. Trypanosomes appeared in the blood to-day, 69 days after second injection.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 23	–	–	–
„ 30	...		–
Oct. 3	...	–	–
„ 10	...	–	–
„ 15	...	–	–
„ 20	...	–	–
„ 27	...	–	–
Nov. 3	...	–	–
„ 11	...	–	–
„ 17	...	–	–
„ 24	...	–	–
Dec. 1	...	–	–
„ 15	...	–	–
„ 29	...		–
1904.			
Jan. 12	...	–	–
„ 19	...	–	+
„ 26	...	–	+
Feb. 2	...	–	+
„ 9	...	–	–
„ 16	...	–	+
„ 23	...	–	+
Mch. 1	...	–	–
„ 8	...	–	–
„ 15	...	–	+
„ 22	...	–	–
„ 29	...	–	–
April 5	...	–	+
„ 12	...	–	–
„ 17	...		–
„ 26	...	–	–

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
May 3	...	–	+
„ 10	...	–	+
„ 17	...	–	–
„ 31	...	–	–
June 14	...		–
„ 21	...	–	–
„ 28	...	–	–
July 12	...	–	–
„ 19	...	–	–
„ 26	...	–	–
Aug. 2	...	–	–
„ 16	...	–	–
„ 23	...	–	–
„ 30	...	–	–
Sept. 3	...	–	–

September 3, 1904. The animal died to-day. It had been partially devoured by another cat. The general condition good. Superficial glands are not enlarged. Coat is in good order. No opacity of corneæ. No œdematous swellings. No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Shows nothing noteworthy. The examination of the blood from this organ shows no trypanosomes.

Lungs.—Both healthy.

Liver.—Rather pale, otherwise healthy.

Kidneys.—Pale, otherwise both healthy.

Lymphatic glands.—Are not enlarged.

Remarks.—This experiment illustrates the course of the disease in the cat. Like the dog this animal shows a very slight susceptibility, the trypanosome tending to die out after being in the blood for a short time. This animal probably died from the effects of traumatism.

Experiment 308. Cat, Young.

To note the effect of subcutaneous injection of blood from a case of sleeping sickness into a young cat.

June 23, 1904. Injected subcutaneously 2·5 c.c. of blood from a case of sleeping sickness. The blood contained numerous active trypanosomes.

July 12. Injected subcutaneously 3·5 c.c. of blood from same case of sleeping sickness.

July 26. Trypanosomes were found in the blood for the first time the 14th day after 2nd injection.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Malar.	Filar.	Tryp.
1904.			
June 28	...	...	–
July 12	...	...	–
„ 19	...	...	–
„ 26	...	...	+
Aug. 2	...	...	+
„ 9	...	...	+
„ 16	...	...	+
„ 23	...	...	+
„ 30	...	...	+
Sept. 6	...	...	+
„ 13	...	...	+
„ 27	...	...	–
Oct. 4	...	...	–
„ 11	...	...	–

Remarks.—This experiment shows that the cat can be infected with the trypanosoma derived from a case of sleeping sickness. Experiment 198 shows that the cat was susceptible also to the infection by the trypanosoma derived from the blood of a man showing no signs of the disease.

On the effect of the injection of these Trypanosomes into Guinea-pigs, Donkeys, Oxen, Sheep and Goats.

EXPERIMENT 82. GUINEA PIG.

To note the effect of subcutaneous injection of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into guinea pig.

May 5, 1903. Injected 5 c.c. of cerebro-spinal fluid containing trypanosomes into this guinea pig subcutaneously.

September 1, 1903. Injected 2 c.c. cerebro-spinal fluid from case of sleeping sickness subcutaneously.

August 18, 1904. Injected 3 c.c. of cerebro-spinal fluid from case of sleeping sickness. The cerebro-spinal fluid contained many active trypanosomes.

Trypanosomes remained absent from the blood of this animal until after the third injection. They were first observed in the blood on October 4 and continued present.

Remarks.—In this guinea pig also trypanosomes have appeared in the blood, thus showing that the guinea pig is not absolutely refractory.

Experiment 81. Guinea Pig (Female).

To note the effect of subcutaneous injection of blood containing trypanosomes from man showing no signs of sleeping sickness into a guinea pig.

May 1, 1903. Injected ½ c.c. of blood from Case 66, Jordien Murjan, containing trypanosomes.

September 21. Injected 5 c.c. of blood from Jordien Murjan subcutaneously.

June 23. Injected 2·5 c.c. blood from case of sleeping sickness. The blood contained trypanosomes.

No trypanosomes were found in the blood up to June 28, 1904.

The following table shows the presence or absence of trypanosomes in the blood after that date :—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
July 12	...	...	−
„ 26	...	...	−
Aug. 2	...	...	+
„ 4	...	...	+
„ 9	...	...	−
„ 16	...	...	+
„ 23	...	...	+
„ 30	...	...	+
Sept. 6	...	...	+
„ 13	...	...	+
„ 27	...	...	+
Oct. 4	...	...	+
„ 11	...	...	+
„ 18	...	...	+
Nov. 2	...	...	+

Remarks.—In this case the trypanosomes appeared in the blood after repeated injections; the blood used in the last injection contained a very large number of trypanosomes.

Experiment 306. Guinea Pig.

To note the effect of subcutaneous injection of blood containing trypanosomes from a case of sleeping sickness into a guinea pig.

June 23, 1904. Injected 2·5 c.c. of blood from a case of sleeping sickness. The blood contained many trypanosomes.

July 12. Injected 3 c.c. of blood from a case of sleeping sickness. The trypanosomes were numerous in the blood injected.

No trypanosomes were found in the blood of this animal at any time during the course of the disease.

Experiment 101. Donkey.

To note the effect of subcutaneous injection of blood containing trypanosomes from man showing no obvious signs of sleeping sickness into donkey.

May 11, 1903. Examined blood. No trypanosomes. No malaria.

May 15. Injected 10 c.c. blood from Case 68, Bara Risgallah, into this donkey.

May 26. Again injected 10 c.c. blood from Case 68.

May 27. To-day large swelling was noticed in the region of the second injection.

June 5. Abscess opened; several ounces of pus evacuated.

September 21. Again injected with 10 c.c. blood from case Jordien Murjan.

No trypanosomes were found in the blood of this animal at any time during the course of the disease.

October 13. The blood of this animal never having shown the presence of trypanosomes even after injection of blood, it was tested with one of the animal varieties of trypanosomes, vide Experiment 229.

Experiment 312. Donkey.

To note the effect of subcutaneous injection of blood containing trypanosomes from a case showing no signs of sleeping sickness into a donkey.

August 6, 1904. Injected subcutaneously 7 c.c. of blood from Case 304, Manawa. The blood contained numerous active trypanosomes.

August 18. Again injected 10 c.c. of blood.

No trypanosomes were found in the blood of this animal at any time during the course of the disease.

Experiment 305. Donkey.

To note the effect of subcutaneous injection of cerebro-spinal fluid from a case of sleeping sickness into a donkey.

June 15, 1904. Injected 2 c.c. of cerebro-spinal fluid from a case of sleeping sickness. The cerebro-spinal fluid contained many active trypanosomes.

July 15. Injected 4 c.c. of cerebro-spinal fluid from a case of sleeping sickness.

The trypanosomes were never found in the blood of this animal at any time.

Experiment 132. Ox, Small Yellow.

June 17, 1903. Blood examined, trypanosomes absent.

June 21. Injected subcutaneously 10 c.c. of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into this ox.

August 25. Injected subcutaneously 10 c.c. of cerebro-spinal fluid from case of sleeping sickness.

September 1. Again injected subcutaneously 10 c.c. of cerebro-spinal fluid into this ox.

September 14. Injected subcutaneously 10 c.c. of cerebro-spinal fluid from case of sleeping sickness.

June 15, 1904. Injected subcutaneously 4 c.c. of cerebro-spinal fluid containing many trypanosomes from a case of sleeping sickness.

August 18. Injected subcutaneously 10 c.c. of cerebro-spinal fluid containing many trypanosomes.

No trypanosomes were ever detected in the blood of this animal.

Experiment 148. Ox.

July 1, 1903. Blood examined, trypanosomes absent.

July 22. Injected subcutaneously 10 c.c. of blood from Case 64, Jordien Murjan, into this ox.

September 21. Again injected subcutaneously 5 c.c. of blood containing active trypanosomes from Jordien Murjan.

September 23, 1904. Injected subcutaneously 7 c.c. of blood from Case 304, Manawa. The blood contained many active trypanosomes.

Trypanosomes were never detected in the blood of this animal at any time.

Experiment 89. Sheep, Brown.

To note the effect of subcutaneous injection of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into a sheep.

May 11, 1903. Injected 10 c.c. of cerebro-spinal fluid containing trypanosomes from a case of sleeping sickness into this sheep.

June 30. Again injected 10 c.c. of fluid.

August 25. 10 c.c. of cerebro-spinal fluid injected.

September 1. 10 c.c. of cerebro-spinal fluid injected.

September 14. 10 c.c. of cerebro-spinal fluid injected.

June 15, 1904. Injected 2 c.c. of cerebro-spinal fluid containing many trypanosomes.

July 15. Injected 4 c.c. of cerebro-spinal fluid containing many trypanosomes.

August 18. Injected 6 c.c. of cerebro-spinal fluid containing many trypanosomes.

Trypanosomes were never found in the blood of this animal. The blood was examined weekly.

Remarks.—Although repeated injections of the fluid were made in this case, yet the trypanosomes have never appeared in the blood of the animal.

Experiment 149. Sheep, Small Brown and White.

To note effect of subcutaneous injection of blood containing trypanosomes from a man showing no obvious signs of sleeping sickness into sheep.

June 25, 1903. Injected subcutaneously 5 c.c. blood from Case 63, Kumsarsabba, containing active trypanosomes.

September 23. Again injected 10 c.c. blood subcutaneously from case Karala Bariji.

Trypanosomes were never found in the blood of this animal. The blood was examined weekly.

November 12. Sheep died this afternoon. Post-mortem.

The body was not emaciated.

Heart.—Fat about base partially absorbed. Blood very pale.

Lungs.—Nothing noteworthy.

Liver, Spleen and Kidneys.—Showed no naked eye change.

Remarks.—This animal never showed the trypanosomes in his blood. It was inoculated on two occasions with blood.

Experiment 90. Goat.

To note effect of subcutaneous injection of blood containing trypanosomes from a man showing no signs of sleeping sickness into a goat.

May 11, 1903. Injected subcutaneously 5 c.c. of blood from Case 64, Jordien Murjan, containing trypanosomes, into this goat.

September 23. Injected subcutaneously 10 c.c. of blood from Case 63, Karala Bariji.

June 23, 1904. This animal having never shown trypanosomes in the blood, 5 c.c. of blood from a sleeping sickness case was injected subcutaneously.

July 15. Trypanosomes have not appeared in the blood, 4 c.c. of cerebro-spinal fluid from a case of sleeping sickness was injected.

August 18. Again injected 6 c.c. of cerebro-spinal fluid containing many active trypanosomes from a case of sleeping sickness.

August 31. Trypanosomes appeared in the blood to-day, thirteenth day after last inoculation.

Trypanosomes were once found in the blood of this animal.

Remarks.—This animal has shown trypanosomes in the blood. It would appear, therefore, that the goat is to a very

slight extent susceptible to infection by Trypanosoma gambiense.

Experiment 313. Goat.

To note the effect of subcutaneous injection of blood containing trypanosomes from a case showing no signs of sleeping sickness into a goat.

August 6, 1904. Injected 5 c.c. of blood from Case 304, Manawa. The blood contained numerous active trypanosomes.

Trypanosomes were never found in the blood of this animal.

Experiment 152. Mr. Pordage's Ox.

June 3, 1903. Found trypanosomes in blood. Injected dog, Experiment 128.

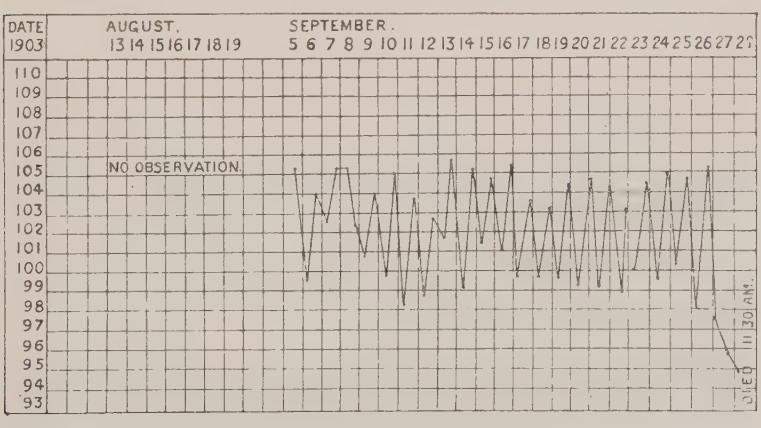
August 13. We received this ox from Mr. Pordage. It is merely a hide-bound skeleton.

August 16. No trypanosomes found in films, but in numbers after centrifuging. Again injected blood into dog, Experiment 128.

September 5. Animal is getting gradually thinner. The superficial lymphatic glands are greatly enlarged. About 30 c.c. of blood drawn off and examined after centrifuging, but no trypanosomes were found.

September 28. Animal was unable to walk. The temperature fell to 94·6. He died at 11.30 a.m.

The following chart represents the course of the fever for about one month before death.



The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
1903.			
June 3	...	...	+
Aug. 16	...	...	+
„ 19	...	...	+
Sept. 5	...	...	−
„ 16	...	...	−
„ 28	...	...	−

September 28. Died at 11.30 a.m. Post-mortem.

The body is profoundly emaciated. The superficial glands were generally enlarged and on section distinctly congested. A little jelly-like material present in subcutaneous tissue. Left cornea showed some opacity, none of right.

On opening the body, a little clear fluid escaped from the pericardial cavity—no increase of fluid in pleural or peritoneal cavities.

Heart.—Pale, shows yellow jelly-like material round base. Two small petechiæ seen under endocardium of left ventricle.

Lungs.—Both healthy.

Liver.—Contained two flukes, otherwise healthy.

Spleen.—Somewhat enlarged.

Kidneys.—Pale, otherwise nothing noteworthy.

Glands.—Retroperitoneal and mesenteric were enlarged.

Remarks.—This variety of trypanosoma more closely approaches the Trypanosoma gambiense than the other animal varieties which we have investigated in Uganda. Dogs are very susceptible to the other animal varieties, but proved refractory when inoculated with this variety.

10. *Further Observations on the Distribution of Glossina palpalis.*

Since the last report, further observations have been made on the distribution of the fly and sleeping sickness. The results of these additional observations have been added to the maps of the distribution given in the Further Report, which have been extended in order to embrace them. Its occurrence round Lake Albert is interesting and important. In the light of this discovery, additional significance was given to a case of sleeping sickness coming from this district. The following are the chief points in the case:—

The patient was a Swahili sailor, named Sururu Bin Mze, who was employed on the Government boat running between Butiaba and Wadelai. Two years ago he came from Mombasa, and passed through Entebbe, remaining there for a day only, and then proceeded direct to Lake Albert. He remained at his work for two years; being then time-expired, he was discharged. On the journey to Entebbe he became ill, and when admitted

MAP SHOWING THE DISTRIBUTION OF GLOSSINA PALPALIS.

The Red Dots show localities where Tsetse Fly was obtained.

Gondokoro
Lokoya
Bari
PROVINCE
Dufile
NIMULI
Fadibek
Shuli
RIVER NILE
Wadelai
Victoria Nile R.
Fajao
Unyoro
ALBERT NYANZA
Unyoro
LAKE CHOGA
Mruli
(Buruli)
Elgon
Mt ELGON
Bugerere
R. Nile
Buyaga
Bugangezi
(Bugangadzi)
Singo
Bulamwezi
(Bulemezi)
Usoga
Toro
Bwekula
Busiro
Kiadonda
Kampala
Chagwe
Busuju
Butambala
Gomba
(Butumzi)
Mawokota
Entebbe
(Port Alice)
Uvuma
EAST AFRICA PROTECTORATE
Mawogola
(Mahogoro)
Kabula
Buddu
Sese Ids
Sese
LAKE ALBERT EDWARD
Ankole
Koki
VICTORIA NYANZA
Anglo-German Boundary
Ft Shirati

30° 31° 32° 33° 34° 35°
5° 4° 3° 2° 1° 0° 1°

Scale of Miles.
0 10 20 30 40 50 60 70

(Wt 9367 1375 8/05 H&S 7390)

MAP SHOWING THE DISTRIBUTION OF SLEEPING SICKNESS IN UGANDA.

The Red Dots show where Sleeping Sickness is prevalent.

The Crosses represent cases imported from Sleeping Sickness area.

30° 31° 32° 33° 34° 35°

5° 4° 3° 2° 1° 0° 1°

Gondokoro

Lokoya

Bari

PROVINCE

Dufile

NIMULI

Fadibek

Shuli

Wadelai

RIVER NILE

Victoria Nile R.

Tajao

Unyoro

ALBERT NYANZA

Unyoro

Mruli
(Buruli)

LAKE CHOGA

Bugerere

Elgon

MT ELGON

Buyaga

Bugangezi
(Bugangadzi)

Singo

Bulamwezi
(Bulemezi)

R. Nile

Usoga

Toro

Bwekula

Busiro

Kiadonda

Kampala

Chagwe

Busuju

Gomba
(Butumzi)

Butembala

Mawokota

Entebbe
(Port Alice)

Uvuma

EAST AFRICA PROTECTORATE

Mawogola
(Mahogoro)

Kabula

Buddu

LAKE ALBERT EDWARD

Sese Ids

Sese

Ankole

Koki

VICTORIA NYANZA

Anglo-German Boundary

Ft Shirati

Scale of Miles.

0 10 20 30 40 50 60 70

(WC 9387 1,571 8/05 H&S 7,190

into hospital here on August 17, 1904, he had undoubted signs of sleeping sickness, with many trypanosomes in the glands and cerebro-spinal fluid.

The question arises, did this man acquire the disease locally, or was it an imported case? In any case, an individual harbouring so many trypanosomes could readily have infected flies in the belt in which he was working, and so spread the disease. Further information on this point is being obtained.*

Dr. C. A. Wiggins made a journey from Mumia's to Shirati and ascertained the distribution of the fly and sleeping sickness there. In his Report to the P.M.O. East Africa and Uganda Protectorates, dated 30th March, 1904, he mentions a point of considerable interest. He states, "I pitched my tent near Omorie's, close by the river, which runs into Homa Bay, and here I found no tsetse and no sleeping sickness, which surprised me, as I knew sleeping sickness was present on the Lake shore. The country here is open plain, more or less cut off from the Lake by a chain of small circular hills. Afterwards, when interviewing the chief, he told me that he had had sleeping sickness in his villages nearly three years ago, but there was none now, as he had forbidden his people to go to the Lake for fish, or to mix with the Wagemi near the Bay. When I told him that sleeping sickness was caused by the bite of the tsetse, he and all his men readily believed it."

Dr. Wiggins' general conclusions as a result of his observations on the journey are, "(1)—That where there are trees or bushes near the water the flies are found, and sleeping sickness occurs in these places. Conversely, where there are no trees there are no flies and no sleeping sickness; papyrus does not shelter them: also, that there is sleeping sickness inland among those tribes who go to the lake for fish at any point where tsetses are at the Lake shore. (2)—That sleeping sickness spread from Uganda and Usoga eastward and southward. (3)—That there is no sleeping sickness east of a line drawn from the Maragoli hills down the Maragoli stream to the bay, and then across the bay (Kavirondo) to Homa, the three or four cases east of this probably imported. This line is also the eastern limit of the distribution of the tsetse fly with the exception of Kibuye, *i.e.*, Port Florence District. (4)—That the only river which carries the fly inland is the Kujá river, which is the only one that has trees at its mouth and thick vegetation along its course."

The latest information shows that sleeping sickness is occurring on the shores of the Albert Edward Lake.

* *Vide* Report 12 (p. 273).

11. *The Tsetse Flies (Glossina palpalis) which had previously fed on a case of Sleeping Sickness or were freshly caught, can produce in the Monkey an exactly similar disease to that produced by inoculation of fluid containing Trypanosoma gambiense.*

Since the publication of the last Report the after-history of several of the monkeys in whom the infection was produced, either by freshly caught flies at Entebbe, or flies which had previously fed on sleeping sickness cases, has been studied.

The result of these investigations shows that the disease, whether induced by the injection of fluid containing the Trypanosoma gambiense, by the bite of the fresh fly or previously infected ones, is, in the monkey, identical in all respects. These facts strongly support the contention that the fresh fly trypanosoma is the Trypanosoma gambiense.

A point of interest and importance in this connection is that since the hut tax labourers (one in every two or three of whom had the Trypanosoma gambiense in his blood) have left the fly belt at Entebbe, it has taken a very much larger number of flies to infect the monkey than it did when they were present. It is, therefore, fair to assume that the chief source at Entebbe, from which the wild fly obtained its supply of trypanosomes, was the body of men brought in from the various districts for the purpose of hut-tax labour.

Experiment 97. Monkey (*Cercopithecus sp.*).

To observe the course of the disease after infection by feeding flies on this monkey eight hours after feeding on a sleeping sickness case.

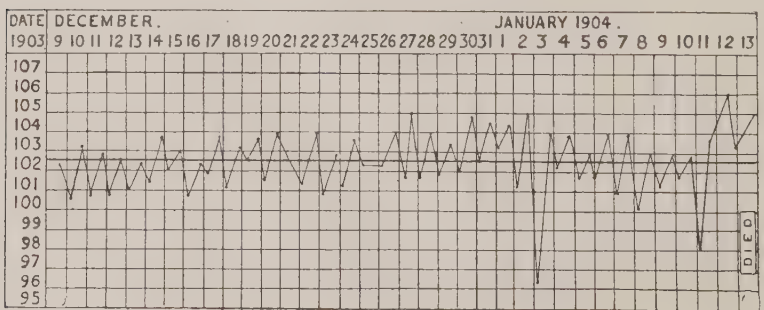
July 1, 1903. Trypanosomes are noted as being in the blood for the first time.

December 18. Animal is beginning to get out of condition.

January 3rd, 1904. Animal has now assumed the characteristic attitude. He is very weak and ill.

January 13. This afternoon he collapsed on the ground, and had convulsive movements of limbs.

The following chart shows the temperature curve :—



The following table shows the presence or absence of trypanosomes in the blood and cerebro-spinal fluid.

Date.	Parasites in blood.			Parasites in C.S.F.	
	Filaria.	Malaria.	Tryp.	Tryp.	Strept.
1903.					
July 2 ...	...	+	+	...	...
Aug. 3 ...	...	+	−	...	...
„ 21 ...	...	+	−	...	...
Sept. 12 ...	...	+	−	...	...
„ 25 ...	...	+	−	...	...
Oct. 8 ...	...	+	-	...	...
Dec. 10 ...	...	+	−	...	...
„ 13 ...	...	−	−	...	...
„ 18 ...	...	+	−	...	...
1904.					
Jan. 3 ...	...	+	−	...	...
„ 9 ...	...	+	-	...	...
„ 13 ...	...	+	+	−	...

January 13. Animal died suddenly at 5 p.m. Post-mortem at once. The body is rather emaciated. Pupils equal and normal. Slight general enlargement of superficial lymphatic glands.

Brain.—On removing the calvarium and reflecting the dura mater some congestion of the superficial vessels is seen. No distinct flattening of convolutions. Cerebro-spinal fluid examined under the microscope, no active trypanosomes seen. Brain removed entire for minute examination. Some increase of fluid in pericardial and peritoneal cavities, no increase of pleural fluid.

Heart.—Nothing noteworthy. Blood from this organ examined on day of death showed the presence of trypanosomes.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged.

Kidneys.—Both healthy.

Glands.—In mesentery and along great vessels are enlarged.

Remarks.—This experiment is of importance as affording proof that the trypanosoma introduced by the bite of flies which had previously fed on a case of sleeping sickness, is capable of inducing in the healthy monkey exactly the same phenomena as those produced by the injection of cerebro-spinal fluid or blood from a sleeping sickness case. The trypanosomes could not be detected in the peripheral circulation on several occasions. They were, however, present on the day of death.

There was no other cause to account for the animal's death apart from the trypanosoma infection. The naked eye changes in the brain were slight.

EXPERIMENT 228. MONKEY (*Cercopithecus sp.*).

To note the effect of the trypanosoma carried by the tsetse flies freshly caught in the vicinity of Entebbe on a monkey.

October 12, 1903. Blood examined. No trypanosomes. Malaria present.
„ 13, „ Fed 49 flies freshly caught.
„ 14, „ „ 49 „
„ 15, „ „ 24 „
„ 16, „ „ 43 „
„ 17, „ „ 14 „
„ 18, „ „ 18 „
„ 19, „ „ 0 „
„ 20, „ „ 25 „
„ 21, „ „ 12 „
„ 22, „ „ 10 „
„ 23, „ „ 15 „
„ 24, „ „ 32 „
„ 25, „ „ 57 „
„ 26, „ „ 0 „
„ 27, „ „ 32 „
„ 28, „ „ 16 „
„ 29, „ „ 28 „
Blood examined. Trypanosomes absent. Malaria present.
October 30, 1903. Fed 52 flies.
„ 31, „ „ 24 „
November 1, „ „ 28 „
„ 2, „ „ 0 „
„ 3, „ „ 26 „
„ 4, „ „ 14 „
„ 5, „ „ 30 „
Blood examined. Trypanosomes absent. Malaria present.
November 6, 1903. Fed 20 flies.
„ 7, „ „ 24 „
„ 8, „ „ 17 „
„ 9, „ „ 0 „
„ 10, „ „ 20 „
„ 11, „ „ 18 „
„ 12, „ „ 20 „
Blood examined. Trypanosomes absent. Malaria present.
November 13, 1903. Fed 14 flies.
„ 14, „ „ 26 „
„ 15, „ „ 15 „
„ 16, „ „ 0 „
„ 17, „ „ 28 „
„ 18, „ „ 18 „
„ 19, „ „ 48 „
Blood examined. Trypanosomes absent. Malaria present.
November 20, 1903. Fed 20 flies.
„ 21, „ „ 0 „
„ 22, „ „ 30 „

November 23, 1903. Fed 0 flies.
„ 24, „ „ 20 „
„ 25, „ „ 14 „
„ 26, „ „ 30 „

Blood examined. Trypanosomes *present*. Malaria present.

June 18, 1904. Animal has been distinctly out of condition, and lately has been crouched up. Lumbar puncture at 12.15 p.m.; 2 c.c. cerebro-spinal fluid obtained; this was centrifuged and active trypanosomes obtained.

The temperature from December, 1903, till March, 1904, showed a slight evening rise. From April, 1904, the temperature fell below normal, the morning temperature going as low as 96°.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Nov. 26	–	+	+
Dec. 3	...	+	–
„ 7	...	+	+
„ 10	...	+	+
„ 17	...	+	+
„ 24	...	+	
1904.			
Jan. 1	...	+	+
„ 7	...	+	+
„ 14	...	+	+
„ 21	...	+	–
„ 29	...	+	+
Feb. 4	...	+	+
„ 10	...	+	+
„ 18	...	+	+
„ 25	...	+	–
March 5	...	+	+
„ 11	...	+	+
„ 18	...	+	+
„ 24	...	+	+
April 7	...	+	–
„ 14	...	+	+
„ 22	...	+	+
„ 29	...	+	+
May 6	...	+	+
„ 12	...	+	+
„ 20	...	+	+
„ 27	...	+	+
June 3	...	+	+
„ 9	...	+	+
„ 16	...	+	+

June 19. Animal has been lying on the ground to-day in a moribund condition. Killed by chloroform.

The body is markedly emaciated. Skin is rough and coat is staring. No sores. The superficial lymphatic glands in both femoral regions and axillæ are enlarged. The pupils are equal and normal. There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Nothing noteworthy. The blood of this organ contains no active trypanosomes. Stained specimens show the presence of trypanosomes.

Lungs.—Both healthy.

Liver.—Rather mottled appearance.

Spleen.—Enlarged and congested.

Kidneys.—Both rather pale, otherwise healthy.

Brain and Spinal Cord.—Show no noteworthy naked eye change. Both preserved for minute investigation.

Glands.—Abdominal, are slightly enlarged.

Remarks.—This experiment illustrates the course of the disease produced by the trypanosomes carried by the tsetse flies (*Glossina palpalis*) freshly caught in the vicinity of Entebbe. It closely resembles the experiments in which Trypanosoma gambiense was injected into the monkey. In both the course of the disease was a prolonged one; the animal in this experiment also showed definite signs for some time before death. At times it presented the same characteristic features met with in the sleeping sickness monkeys. The temperature curve was also very similar. This experiment supports the view that the trypanosoma carried by the freshly caught tsetse flies in Uganda is identical with the Trypanosoma gambiense.

Experiment 301. Monkey (*Cercopithecus sp.*).

Feeding freshly caught tsetse flies on a healthy monkey.

Blood examination. Trypanosomes absent. Malaria absent.

June 10, 1904. Fed 30 flies.
„ 11, „ „ 22 „
„ 13, „ „ 30 „
„ 14, „ „ 24 „
„ 15, „ „ 20 „
„ 16, „ „ 27 „
„ 17, „ „ 12 „
„ 18, „ „ 24 „
„ 20, „ „ 14 „
„ 21, „ „ 20 „
„ 22, „ „ 18 „
„ 23, „ „ 15 „
„ 24, „ „ 21 „

Blood examination. Trypanosomes absent. Malaria absent.

June 25, 1904. Fed 12 flies.
„ 27, „ „ 12 „
„ 28, „ „ 20 „
„ 29, „ „ 16 „
„ 30, „ „ 13 „

July 1, 1904. Fed 14 flies.
„ 2, „ „ 22 „
Blood examination. Trypanosomes absent. Malaria absent.
July 4, 1904. Fed 23 flies.
„ 5, „ „ 26 „
„ 6, „ „ 19 „
„ 7, „ „ 24 „
„ 8, „ „ 21 „
„ 9, „ „ 25 „
„ 11, „ „ 21 „
„ 12, „ „ 23 „
„ 13, „ „ 20 „
„ 14, „ „ 26 „
„ 15, „ „ 27 „
„ 16, „ „ 12 „
Blood examination. Trypanosomes absent. Malaria absent.
July 18, 1904. Fed 32 flies.
„ 19, „ „ 24 „
„ 20, „ „ 40 „
„ 21, „ „ 37 „
„ 22, „ „ 34 „
Blood examination. Trypanosomes absent. Malaria absent.
July 24, 1904. Fed 20 flies.
„ 25, „ „ 28 „
„ 26, „ „ 14 „
„ 27, „ „ 18 „
„ 28, „ „ 36 „
„ 29, „ „ 41 „
„ 30, „ „ 30 „
Blood examination. Trypanosomes absent. Malaria absent.
August 2, 1904. Fed 37 flies.
„ 3, „ „ 30 „
„ 4, „ „ 16 „
„ 5, „ „ 24 „
Blood examination. Trypanosomes absent. Malaria absent.
August 8, 1904. Fed 31 flies.
„ 9, „ „ 32 „
„ 10, „ „ 15 „
„ 11, „ „ 34 „
„ 12, „ „ 12 „
Blood examination. Trypanosomes absent. Malaria absent.
August 13, 1904. Fed 27 flies.
„ 15, „ „ 20 „
„ 16, „ „ 14 „
„ 17, „ „ 18 „
„ 18, „ „ 22 „
„ 19, „ „ 16 „
Blood examination. Trypanosomes absent. Malaria absent.
August 20, 1904. Fed 37 flies.
„ 22, „ „ 27 „
„ 23, „ „ 24 „
„ 24, „ „ 28 „

August 25, 1904. Fed 26 flies.
„ 26, „ „ 29 „
Blood examination. Trypanosomes absent. Malaria absent.
August 27, 1904. Fed 21 flies.
„ 28, „ „ 30 „
„ 29, „ „ 24 „
„ 30, „ „ 16 „
„ 31, „ „ 14 „
September 1, „ „ 30 „
„ 2, „ „ 26 „
Blood examination. Trypanosomes absent. Malaria absent.
September 8, 1904. Fed 27 flies.
„ 9, „ „ 20 „
„ 10, „ „ 37 „
„ 11, „ „ 50 „
„ 13, „ „ 27 „
„ 14, „ „ 30 „
„ 15, „ „ 37 „
Blood examination. Trypanosomes absent. Malaria absent.
September 16, 1904. Fed 24 flies.
„ 17, „ „ 30 „
„ 18, „ „ 20 „
„ 20, „ „ 30 „
„ 21, „ „ 40 „
„ 22, „ „ 8 „
„ 23, „ „ 17 „
Blood examination. Trypanosomes absent. Malaria absent.
September 24, 1904. Fed 24 flies.
„ 25, „ „ 32 „
„ 27, „ „ 12 „
„ 28, „ „ 26 „
„ 29, „ „ 30 „
„ 30, „ „ 14 „
Blood examination. Trypanosomes absent. Malaria absent.
October 1, 1904. Fed 12 flies.
„ 2, „ „ 17 „

Animal died. Blood examination. Trypanosomes absent. Malaria absent.

Remarks.—This experiment is of considerable interest, a total of 2,299 flies fed on this monkey yet trypanosomes did not appear in the blood. This indicates that the removal of hut tax labourers from the fly-belt at Entebbe has materially reduced the number of infected flies. Last year when a large number of hut tax labourers were in the belt, about 185 flies were fed on a monkey and produced trypanosomes in the blood.

The animal became very anæmic and debilitated from the loss of blood occasioned daily by the bites and this no doubt caused its death.

12. *Are other varieties of trypanosomes found in Uganda?*

In addition to the Trypanosoma gambiense, trypanosomes from various sources have been studied. In the last Report, it was shown that oxen in Entebbe belonging to the P.W.D. and sent for examination by Mr. Pordage, had trypanosomes in their blood. In the blood of government cattle at Jinja, Usoga, which were dying at the rate of five or six a day, a trypanosome was constantly found. In the blood of a dog kindly sent by Mr. R. J. Stordy, P.V.O. Uganda and East Africa Protectorates, trypanosomes were present. This animal had accompanied the Abyssinian Boundary Commission. Lastly, in the blood of a mule of Col. Sadler's at Entebbe, a trypanosome was found. The trypanosomes derived from these four sources have been studied side by side here.

13. *The History and distribution of these trypanosomes in Uganda and East Africa.*

A. The oxen of Mr. Pordage, as stated in the last Report, came to Entebbe from British East Africa about the end of 1900. They kept well until they were sent to graze in the forest near the Lake, in which *Glossina palpalis* is found. Since then they have been sick, and Mr. Pordage is of opinion that their illness was contracted whilst grazing there.

B. The cattle which became sick and died at Jinja Usoga, and in whose blood a trypanosome was found by us in August, 1903, came from the Bukedi country in May, 1903. They had been in Wamia District to the south-west of Mount Elgon. The route by which they were marched to Jinja Usoga was *viâ* Igagas, Kibuye, Baleale and Kitindis. They halted at each of these places, and at all of them a species of tsetse fly is found.* To determine whether a trypanosoma occurs in the animals stationed at any of these places, the blood of animals was examined at Kibuye. Mr. Grant kindly made slides from a number of animals in December, 1903. Of ten slides from different domestic animals, trypanosomes were found in two, one in a slide from a donkey, and one from a cow. We were thus able to demonstrate that the necessary factors for the infection of the cattle were present at the halting places.

C. A number of animals which accompanied the Abyssinian Boundary Commission became sick and died, and an examination of one of the sick animals showed that trypanosomes were present in the blood. The animals affected were eleven Boran and Abyssinian ponies, as well as several camels and five English dogs. These all died. None of the Abyssinian donkeys or mules were affected. The English dog examined on August 26th, 1903, was half Airedale and half bull terrier. The animals marched from the boundary to Lake Rudolph, and thence *viâ* Baringo to Nakuru. Two ponies died at Nakuru. The journey from Baringo to Nakuru only occupies four days,

* *Glossina pallidipes*, see map by Mr. E. E. Austen, Report No. 13.

so that, probably, the infection occurred further north. Austen in his Monograph, p. 326, records that *Glossina fusca* has been found on the north-east shores of Lake Rudolph. *Vide* Map of Distribution of Tsetse Flies in Africa (p. 282).

D. A mule used by Colonel Sadler was found in September, 1903, to have trypanosomes in his blood. This animal had been about five years in Africa, firstly, in the East Africa Protectorate, and for the last eighteen months in Uganda.

14. *Can any difference be made out microscopically between these varieties of trypanosomes occurring amongst the domestic animals in Uganda?*

As the same species of trypanosoma varies in size, shape, etc., in the blood of different experimental animals, too much importance cannot be attached to the morphological characters as affording a means of establishing the identity of different trypanosomes. Speaking generally, it may be safely stated that the trypanosomes found in the blood and cerebro-spinal fluid of cases of sleeping sickness, and in the blood of men showing no signs of sleeping sickness, are always smaller than those of the Jinja cattle, Abyssinian or Entebbe mule disease. The variety met with in the mule showed an unusually large number of short "tadpole" forms. This was especially well seen when the blood containing this variety was injected into a guinea pig (*see* p. 154). The variety met with in the Jinja cattle was, as a rule, larger than the others. It is, however, on morphological grounds only, impossible to arrive at a final conclusion as to the identity or otherwise of the various "strains" brought under our notice. Accordingly, in addition to this means of distinction, their differentiation was approached by a study of their reactions in a series of animals. These reactions were contrasted and compared. Further, the injection of animals proved to be immune to one species with the blood containing another strain of trypanosoma, was used as a means of arriving at a conclusion on the question of the identity or not of the various species. In the drawing of the specimens the morphological characters of the trypanosomes are shown.

15. *Are these trypanosomes pathogenic to animals, and can any difference be made out between them by animal experiment?*

In the case of the trypanosoma found in Mr. Pordage's ox, it produced a very chronic malady in the animals under observation, the animals became extremely emaciated with abnormal temperature. They became gradually weaker and finally died.

The trypanosoma obtained from the Jinja cattle produced few symptoms. There was a general enlargement of the lymphatic glands. As a rule the animals died in fairly good

BLOOD OF DOG SUFFERING FROM

JINGA CATTLE DISEASE.

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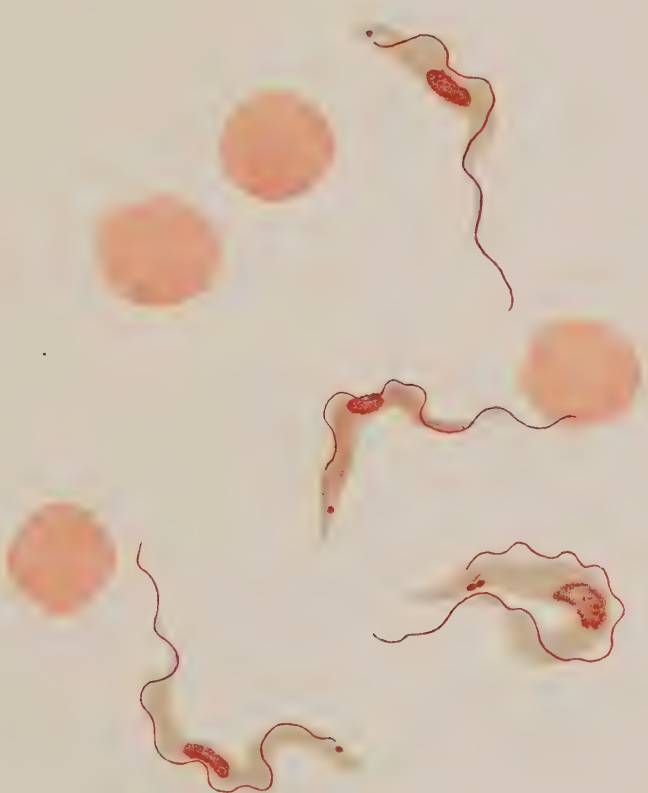
5

BLOOD OF DOG.

ABYSSINIAN TRYPANOSOME.



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condition. On post-mortem examination the cervical and supra-clavicular lymphatic glands were enlarged and congested. The heart showed yellow jelly-like material at the base, and often petechiæ on its external and internal surfaces. The spleen was slightly enlarged. The native name of the disease is *Sutoko*, and has been considered an internal form of *Mukebi*. The trypanosoma was first found in the herd of cattle in August, 1903. The cattle at the station at Jinja were infected to the extent of 24 per cent. of their number. At Kitindi's, near Jinja, 20 per cent. were infected. Mr. A. G. Boyle, Sub-Commissioner of Usoga, reports "that since March, 1904, the cattle have ceased to die amongst the herd." The herd has been kept at Kitindi's, at which place the *Glossina palpalis* is found. These cattle were again examined in September, 1904. The result of the examination showed that 50 per cent. of these cattle had the trypanosoma in their blood. This examination was made to determine whether the cattle were fit to sell or not. The results show the necessity for such examinations before arriving at a definite opinion on the subject. It is further of interest, as showing that the symptoms of the disease amongst these cattle had undergone considerable modification during the year. In August, 1903, the disease ran a very acute course, the animals dying before any marked signs had developed, whilst in September, 1904, although a larger number of cattle were affected, yet none of them were dying. This fact could be explained in two ways: (1), that the parasite had become attenuated, or (2), the animals had become more immune, or it might be a combination of both factors.

The trypanosoma obtained from the animals which became affected on the Abyssinian boundary caused the death of some eleven Boran and Abyssinian ponies, as well as camels and five English dogs. The Abyssinian donkeys and mules did not suffer. One native (Abyssinian) dog, which was the companion of the English dogs, and had accompanied them on the expedition, remained quite healthy. This animal was, however, susceptible to infection, as was proved by injecting it with blood containing this variety of trypanosoma.

The mule at Entebbe in whose blood a trypanosoma was found, when brought to the laboratory in September, 1903, had slight fever and swelling of the lymphatic glands. A few days later it was brought in a moribund condition. No trypanosomes could be found in the peripheral blood microscopically, but injection of susceptible animals proved the presence of the parasites in the blood.

In the following account of the inoculation of the various experimental animals with the blood of animals suffering from the Jinja cattle disease, Abyssinian fly disease, and the mule disease, the observations are given in full, as this is the first time these diseases have been studied, and it is, therefore, of importance that all the experiments on which conclusions as to the nature of the diseases are based should be given in detail.

In the case of the trypanosoma obtained from Mr. Pordage's ox, it was found impossible to infect either a monkey or a dog with this "strain."

The animals used for inoculation were monkeys, dog-faced baboons, dogs, guinea-pigs, rabbits, donkeys, oxen, sheep, and goats.

A.—*Experiments on the effect on monkeys of the injection of blood containing trypanosomes from animals suffering from "the Jinja cattle disease."*

Experiment 154. Monkey (*Cercopithecus sp.*).

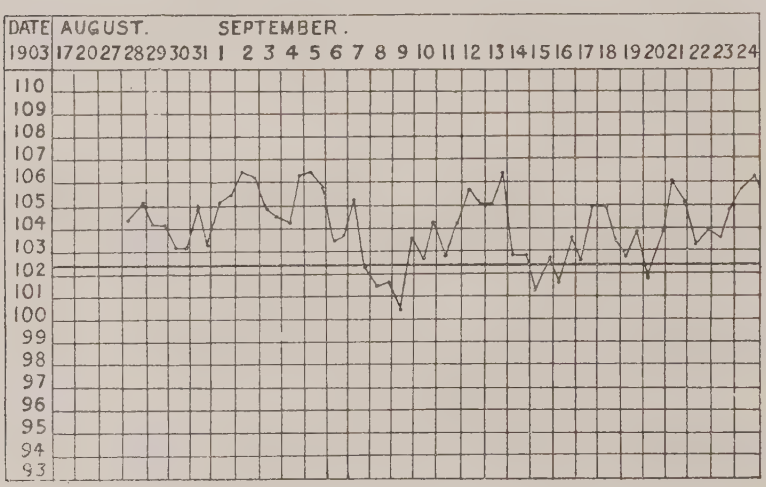
To note the effect of injection of blood from ox suffering from "the Jinja cattle disease" into a monkey.

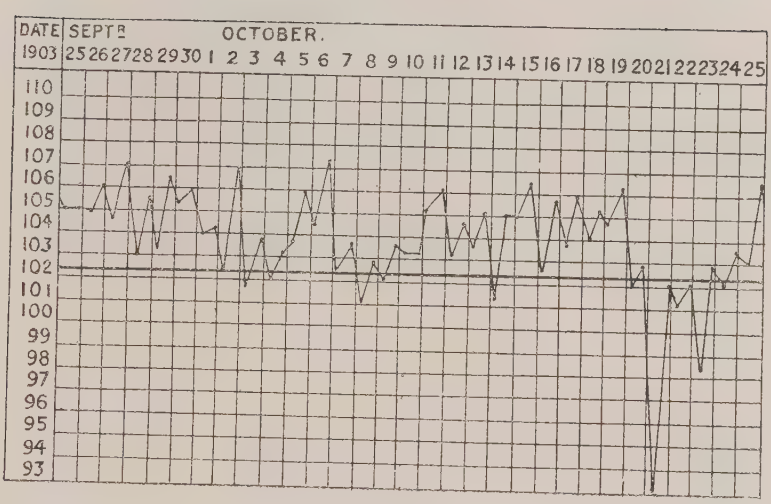
August 17, 1903. Injected subcutaneously 3 c.c. blood containing trypanosomes.

August 27. On examination of the blood trypanosomes were found to be present for the first time; ten days after inoculation.

September 2. Animal is much quieter than usual.

The following chart represents the course of the disease :—




DATE
1903
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25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
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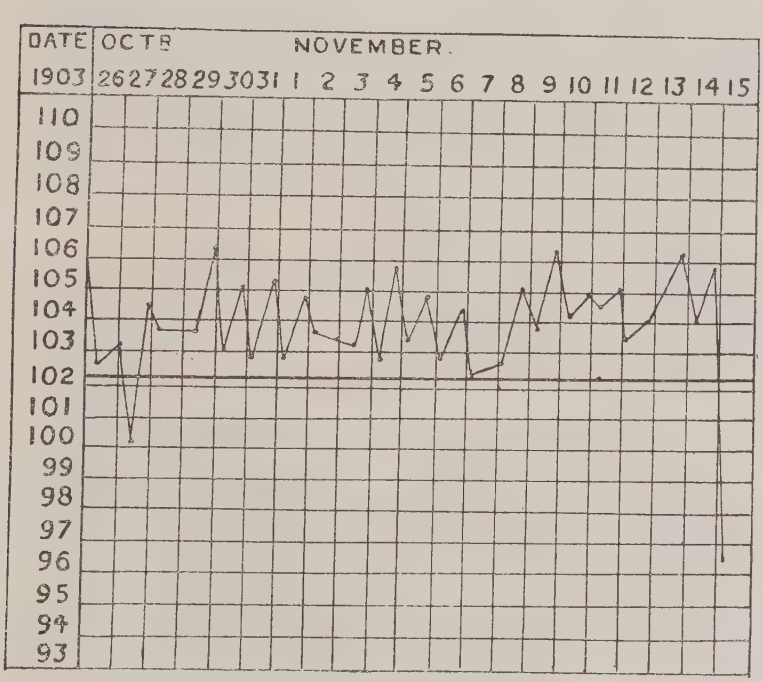
DATE
1903
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The following table shows the presence or absence of trypanosomes in the blood:—

Date. 1903.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
Aug. 17	−	+	−
„ 20	...	+	−
„ 27	...	+	+
Sept. 4	...	+	+
„ 6	...	...	+
„ 12	...	−	+
„ 18	...	−	+
„ 22	...	+	+
„ 25	...	+	+
„ 28	...	...	+
Oct. 2	...	...	+
„ 8	...	+	+
„ 12	...	...	+
„ 22	...	−	−
„ 25	...	...	+
Nov. 4	...	...	+
„ 12	...	...	+

November 15. Animal died at 1.30 p.m. Post-mortem.

The body is emaciated—no enlarged glands or opacity of cornea. There is no increase of fluid in pericardial, pleural or peritoneal cavities.

Heart.—Marked petechiæ on surface—jelly-like substance round base, distinct petechiæ under endocardium of both ventricles.

Lungs.—Both show several small areas of embolism.

Liver.—Nothing noteworthy.

Spleen.—Distinctly enlarged—firm on section.

Kidneys.—Left shows several areas of hæmorrhage on surface and several infarcts on section. Right in similar condition. Glands not enlarged.

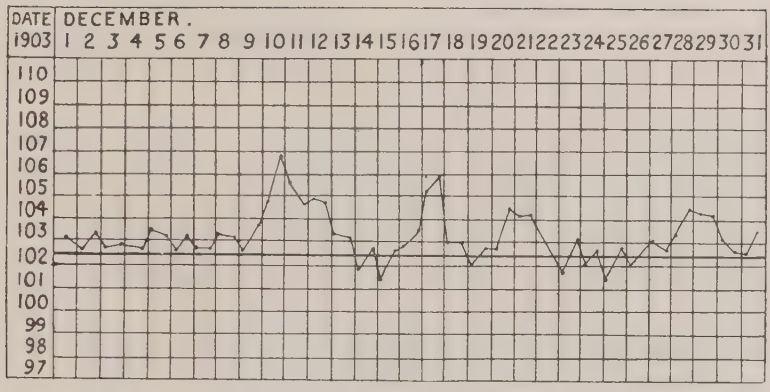
Experiment 263. Monkey (*Cercopithecus sp.*).

To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a monkey.

December 1, 1903. Injected 5 c.c. of blood containing trypanosomes from the heart of Monkey 241 obtained post-mortem.

December 9. Trypanosomes appeared in the blood to-day, 9 days after injection.

The following chart shows the course of the disease:—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1903
DECEMBER.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
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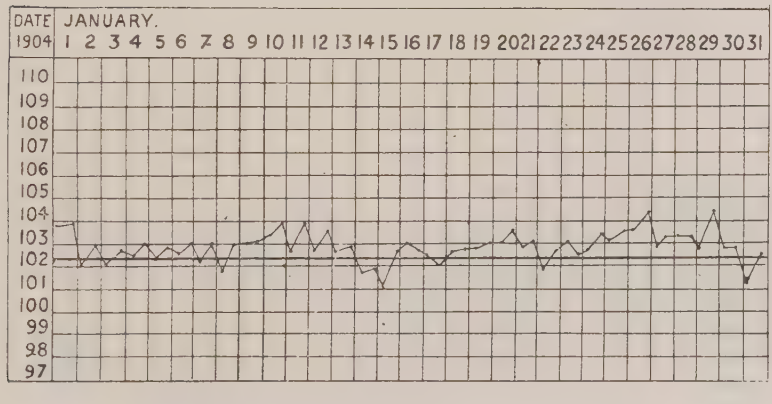
DATE
1904
JANUARY.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
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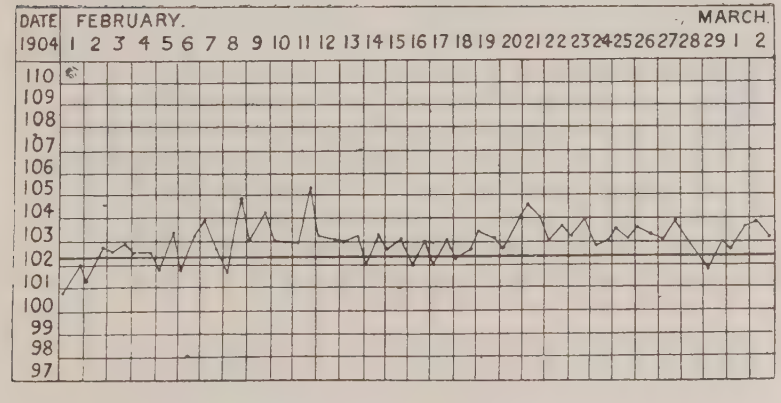
DATE
1904
FEBRUARY.
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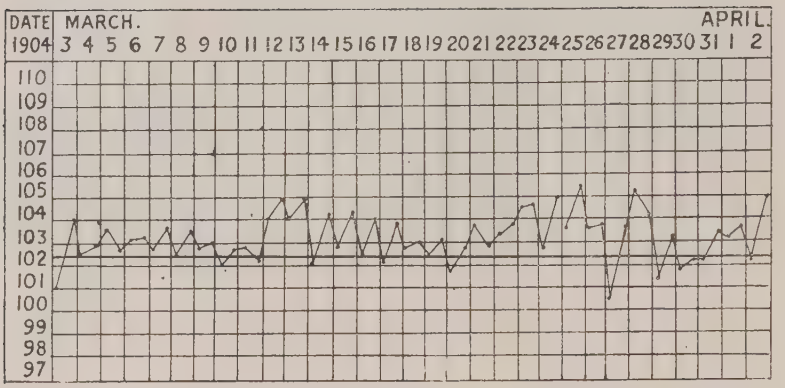
DATE
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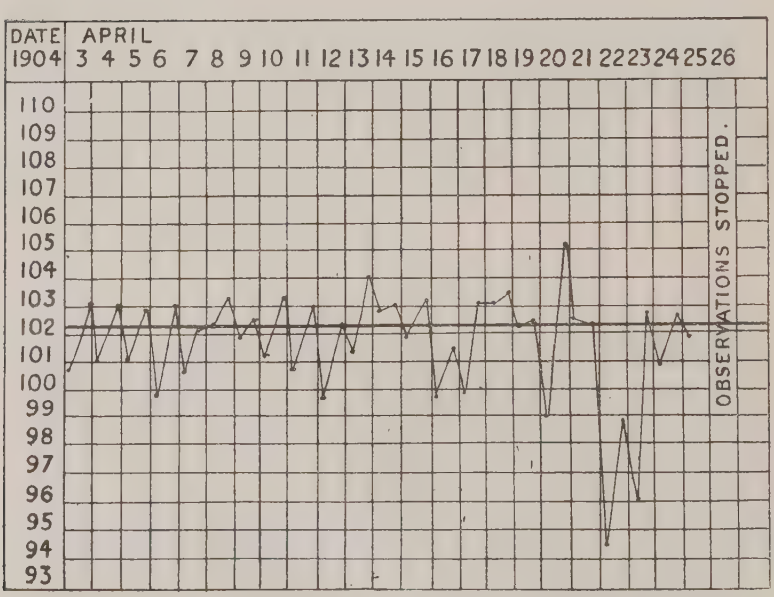
DATE
1904
APRIL
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OBSERVATIONS STOPPED.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Dec. 3	–	+	–
„ 9	...	+	+
„ 17	...	+	+
„ 24	...	+	+
„ 31	...	+	+
1904.			
Jan. 7	...	+	+
„ 15	...	+	+
„ 22	...	+	+
„ 28	...	+	+
Feb. 4	...	+	+
„ 11	...	+	+
„ 18	...	+	+
„ 25	...	+	–
Mar. 4	...	+	+
„ 18	...	+	+
„ 24	...	+	+
April 7	...	+	+
„ 14	...	+	+
„ 22	...	+	–
„ 29	...	+	+
May 6	...	+	+

May 7. Animal was found dead to-day. He had been partially devoured by a jackal in the night, and many of the organs were removed.

The superficial glands are generally enlarged.

Heart.—No jelly-like substance round base

Remarks.—The long duration of this experiment is of interest and a comparison with Experiment 154 suggests that the longer and more chronic course of the disease in this monkey was, probably, due to alteration of the parasite by passage. About a month before its death only amœbic forms of the parasite were seen in the blood and these were very scanty. Afterwards the trypanosomes increased very rapidly, and swarmed in the blood before death to the extent of 38,000 trypanosomes per c.mm.

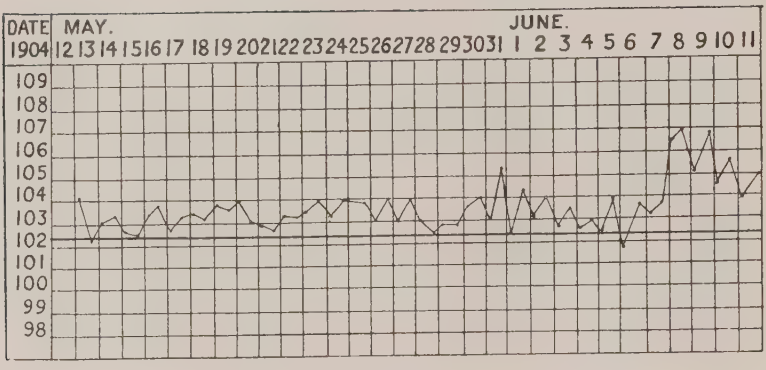
Experiment 292. White-nosed Monkey.

May 12, 1904. Injected 3 c.c. of blood from Monkey 204 (Jinja).

May 31. Injected 1 c.c. blood from dog, Experiment 280.

June 9. Trypanosomes appeared in the blood to-day, 9th day after last inoculation.

The following chart shows the course of the disease :—


DATE
1904
MAY.
JUNE.
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11
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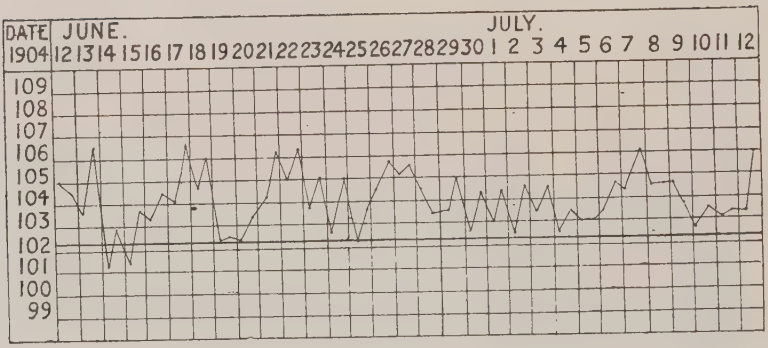
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JULY.
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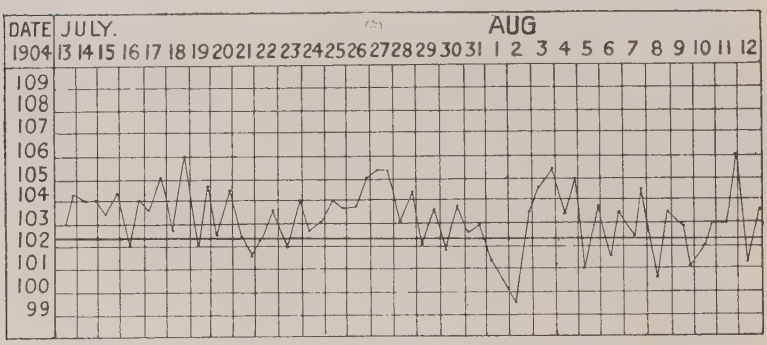
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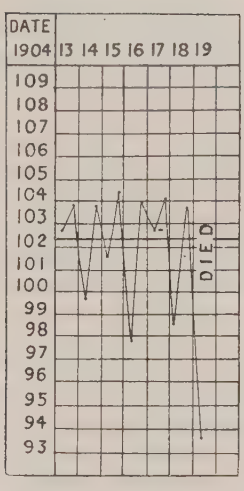


The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Fil.	Mal.	Tryp.
1904.			
May 10	–	–	–
„ 27	...	–	–
June 2	...	–	–
„ 9	...	–	+
„ 16	...	–	+
„ 24	...	–	+
July 2	...	–	–
„ 15	...	–	+
„ 30	...	–	+
Aug. 5	...	–	+
„ 12	...	–	+
„ 19	...	–	+

June 19. Animal died at 4 p.m. Post-mortem at once.

The animal is not much emaciated. The coat is out of condition. The superficial glands are generally enlarged.

Heart.—Shows nothing noteworthy. The blood from this organ contains many active trypanosomes and a considerable number of short forms.

Lungs.—Nothing noteworthy.

Liver.—Appears healthy.

Spleen.—Is enlarged and congested—a smear from the pulp shows a number of trypanosomes in various stages of disintegration.

Kidneys.—Show nothing noteworthy.

Lymphatic glands.—In abdomen are enlarged.

Remarks.—This experiment demonstrates the course of this disease in this variety of monkey.

Experiment 204. Monkey (*Cercopithecus sp.*).

To observe the effect of the infection produced by flies which fed on this animal after having fed 24 hours previously on an animal infected with the trypanosoma of "Jinja cattle disease."

January 28, 1904. The trypanosomes appeared in the blood to-day for the first time since the feeding commenced.

May 11. Animal has become very thin and out of condition. The coat is staring.

The temperature showed a distinct rise in the evening. Shortly before death it became irregular, swinging between 106° and 97°.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
Feb. 4	...	+	+
„ 11	...	+	+
„ 18	...	[illegible]	−
„ 25	...	+	+
Mar. 4	...	−	−
„ 11	...	+	+
„ 18	...	+	+
„ 24	...	+	+
April 7	...	+	+
„ 14	...	+	+
„ 22	...	−	−
„ 29	...	+	+
May 6	...	+	+
„ 12	−	+	+

May 13, 1904. Animal died. Post-mortem.

The body is much emaciated. The lymphatic glands in groin, axillæ and neck are enlarged. Slight increase of fluid in pericardial cavity—no increase of fluid in pleural or peritoneal cavities.

Heart.—Shows nothing noteworthy.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Enlarged—firm on section.

Kidneys.—Both healthy.

Intestines.—Large contains some worms, probably trichocephalus.

Great omentum.—*A number of bodies present which look like "maggots," they are covered by a layer of peritoneum and show contractile movements. There were also smaller structures studded throughout the membrane looking like granulation tissue, especially towards the left side near spleen and left kidneys.

The mesentery was also seen to contain similar bodies.

The specimens were preserved for future study.

Remarks.—This experiment clearly showed that the *Glossina palpalis* is capable of transmitting the trypanosoma of the "Jinja cattle disease" after 24 hours. The disease induced by the bite of the fly ran a course which was somewhat more prolonged than in the case of inoculation of blood from diseased cattle into monkeys. This suggests that by passage through monkeys of this species the virulence of this trypanosome has been attenuated.

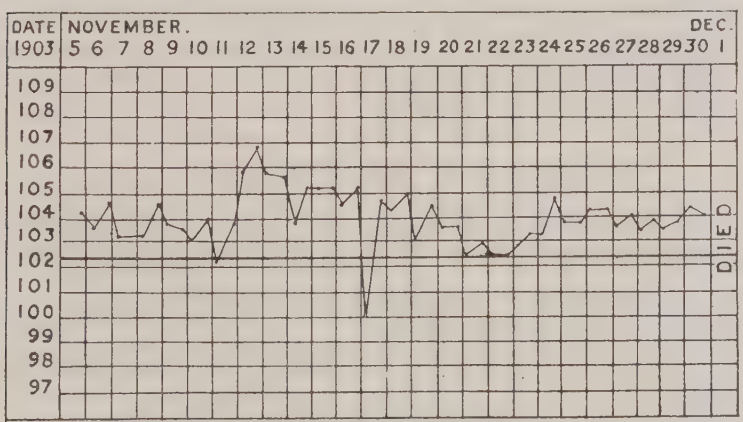
EXPERIMENT 241. MONKEY (*Cercopithecus sp.*).

To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a monkey.

November 9, 1903. Injected 10 c.c. of blood subcutaneously from Dog 234.

November 12. Trypanosomes are present in the blood to-day, 8 days after injection. A filaria was also seen in the blood. It had no sheath; the tail was pointed. Its length was about equal to the *Filaria perstans*.

The following chart shows the course of the disease:—



* Mr. Jeffrey Bell, of the British Museum, on 8th August, 1904, writes "that the parasites are immature examples of *Pentastomum*, several species of which have been found in the peritoneum of monkeys. They would have become mature in the air passages of any carnivora or snake that had eaten the monkey."

The following table shows the presence or absence of filaria and trypanosomes in the blood :—

Date. 1903.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
Nov. 5	−	+	−
„ 12	+	+	+
„ 14	+	...	+
„ 19	...	...	+
„ 26	...	...	+
„ 30	...	...	+

December 1, 1903. Animal died. Post-mortem.

No noteworthy external appearance. No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Shows nothing noteworthy.

Lungs.—Both were distinctly œdematous and showed patchy areas of congestion.

Liver.—Was distinctly fatty.

Spleen.—Was somewhat enlarged and showed small areas like sago grains.

Kidneys.—Nothing noteworthy.

The connective tissue of peritoneum was carefully examined but no trace of a parent filaria could be found there or in the pelvis. Other situations were also examined with negative results.

Brain.—Showed nothing noteworthy.

Remarks.—The course of the trypanosoma infection was probably shortened by the morbid condition found in the lungs and liver. The finding of a filaria in this monkey was of considerable interest. It is the first time a filaria has been found in any of the monkeys here. It does not seem to belong to any of the known varieties.

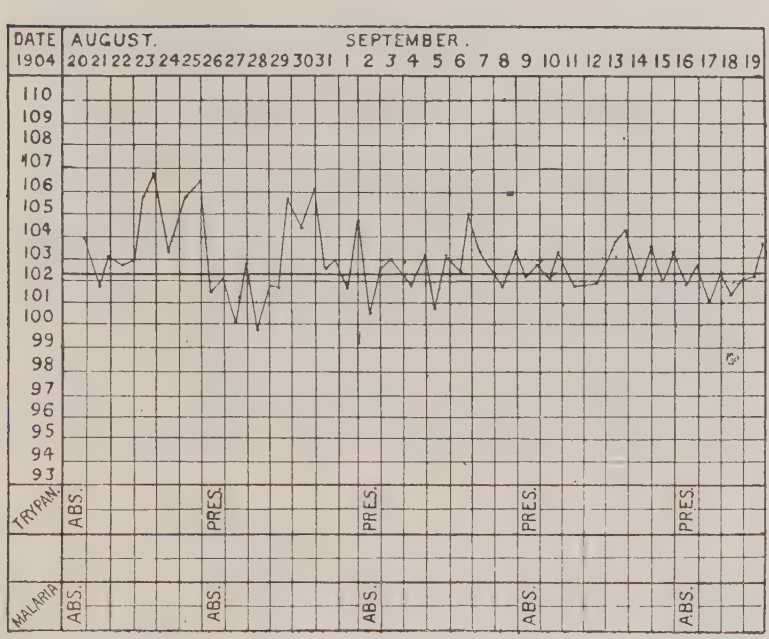
Experiment 315. Monkey (*Cercopithecus sp.*).

To note effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a monkey.

August 19, 1904. Injected 2 c.c. of blood containing many trypanosomes from Monkey 292.

October 2. General condition shows no noteworthy change.

The following chart shows the course of the disease :—


DATE
1904
AUGUST.
SEPTEMBER.
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TRYPAN.
MALARIA.
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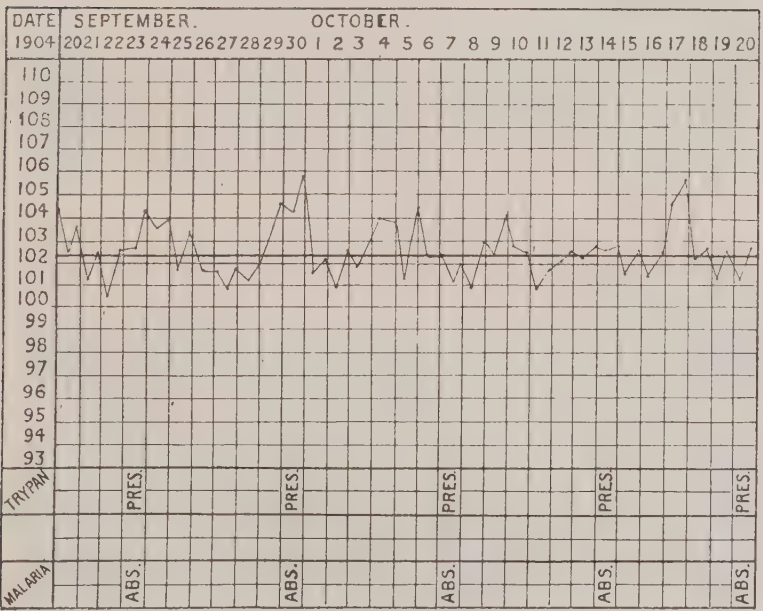
DATE
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OCTOBER.
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MALARIA.
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B. *Experiments on the effect on monkeys of the injection of blood containing trypanosomes from animals suffering from the "Abyssinian fly disease."*

EXPERIMENT 134. MONKEY, WHITE-NOSED (*sp.?*).

To note the effect of blood containing trypanosomes from an animal sent from Abyssinia with a monkey.

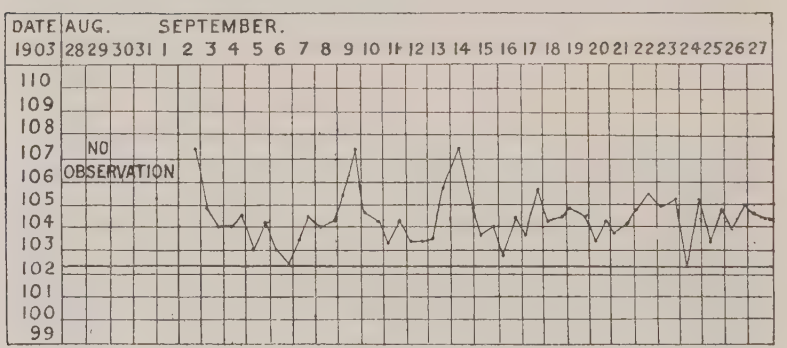
August 28, 1903. 3 c.c. of blood from dog, Experiment 160, subcutaneously.

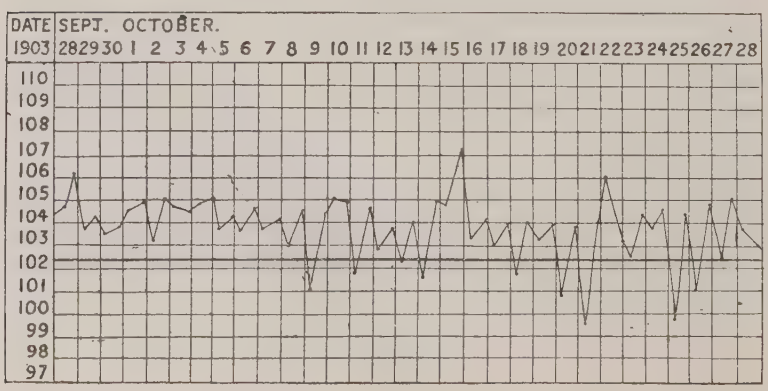
September 2. The blood was examined and trypanosomes were found to be present five days after inoculation.

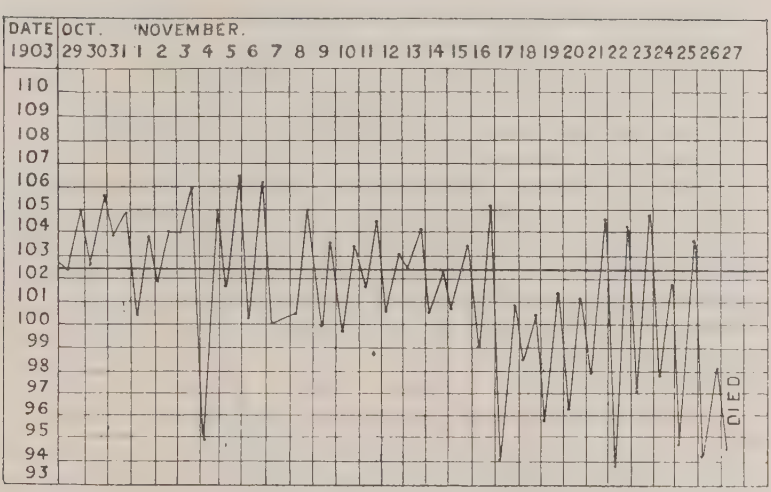
November 7. The animal is getting thin and shows a tendency to lie about. The breathing is rapid.

November 25. This is now very sick and unable to rise.

The following chart represents the temperature curve :—







The following table shows the presence or absence of trypanosomes in the blood :—

Date. 1903.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
Aug. 21	−	+	−
„ 28	...	+	−
Sept. 2	...	...	+
„ 3	...	...	+
„ 4	...	...	+
„ 5	...	...	−
„ 12	...	−	+
„ 18	...	+	−
„ 22	...	...	−
„ 25	...	+	+
„ 28	...	+	+
Oct. 5	...	...	+
„ 12	...	−	−
„ 15	...	...	+
„ 18	...	...	−
„ 22	...	−	+
„ 29	...	...	+
Nov. 5	...	...	+
„ 6	...	−	−
„ 12	...	...	+
„ 17	...	...	+
„ 25	...	...	+

November 27. Animal died. Post-mortem.

The animal is markedly emaciated; no opacity of cornea, glands not enlarged.

On opening the body there is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—A few petechiæ under epicardium of left ventricle Fat at base is absorbed, otherwise normal.

Lungs.—Both show areas of minute ecchymosis.

Liver.—Nothing noteworthy.

Kidneys.—Left shows 2 areas of infarction quite colourless.

Spleen.—Not enlarged.

Glands.—Glands in the mesentery enlarged and congested.

Brain and Spinal Cord.—The dura mater was markedly adherent to the calvarium. No increase of subarachnoid fluid. The convolutions were slightly congested. The brain and spinal cord preserved for minute examination.

Remarks.—This experiment represents the course of the disease in a monkey.

EXPERIMENT 224. MONKEY (*Cercopithecus sp.*).

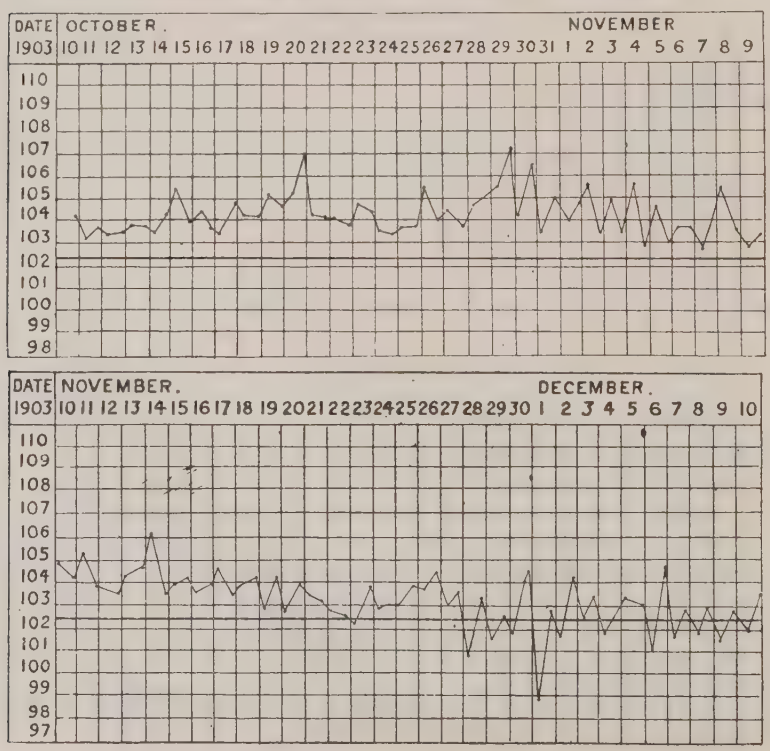
To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a monkey.

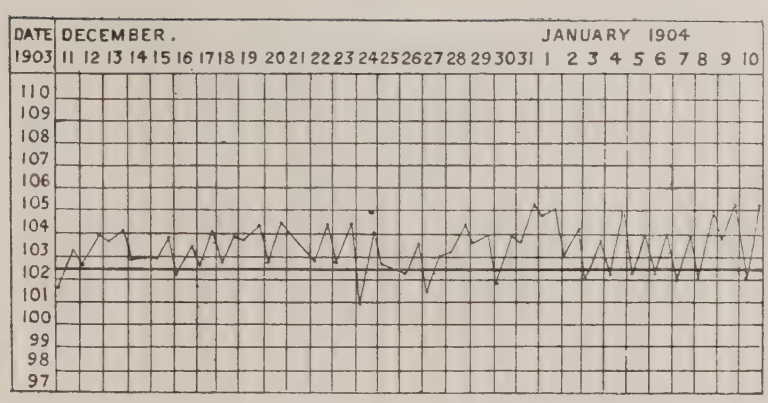
October 10, 1903. Injected 5 c.c. blood from Dog 177 taken post-mortem containing active trypanosomes.

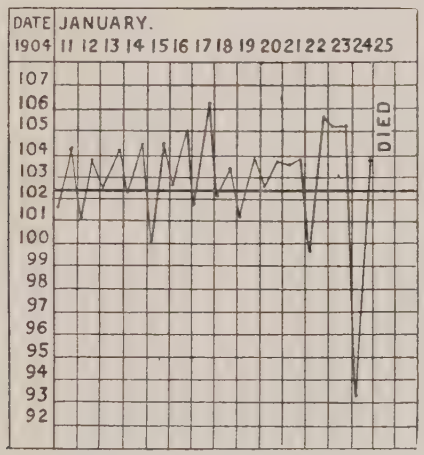
November 16. Re-injected with a few drops of blood from Dog 243 containing active trypanosomes.

January 24, 1904. Animal is very sick. The face is distinctly swollen.

The following chart shows the course of the disease :—







The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Oct. 12	..	+	–
„ 16	...	+	–
„ 22	...	+	–
„ 26	...	+	–
„ 29	...	+	–
Nov. 2	...	+	–
„ 5	...	+	–
„ 12	...	+	.
„ 19	...	+	+
„ 21	...	+	+
„ 25	...	+	+
„ 26	...	+	+

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Dec. 3	...	+	+
„ 10	...	+	−
„ 17	...	+	+
„ 24	...	+	−
„ 31	...	+	+
1904.			
Jan. 1	...	+	+
„ 7	...	+	+
„ 14	...	+	+
„ 21	...	+	+

January 25. Animal died in the night. Post-mortem.

An œdematous swelling on right side of muzzle. The pupils are equal and normal. The superficial glands are slightly enlarged. No emaciation.

Some increase of fluid in pericardial cavity, no increase of fluid in pleural or peritoneal cavities.

Heart.—Appears healthy. Trypanosomes present in the blood of this organ.

Lungs.—Both healthy.

Brain and Spinal Cord.—No naked eye change. Preserved for minute investigation.

Glands.—Abdominal slightly enlarged.

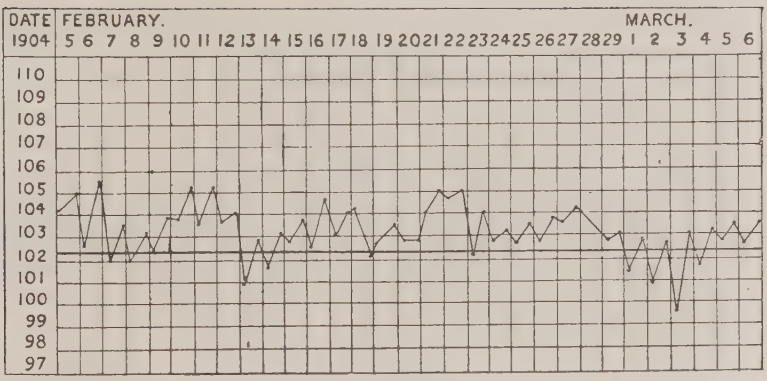
Remarks.—This animal died in comparatively good condition. The experiment illustrates the course of the disease produced by this variety of trypanosomes in a monkey.

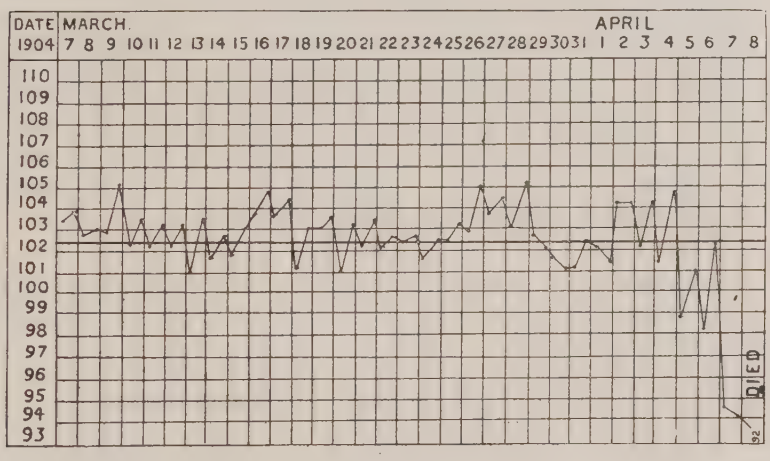
Experiment 252. Monkey (*Cercopithecus sp.*).

To observe the effects of the infection produced by tsetse flies (*Glossina palpalis*) which fed on this animal after having fed 24 hours previously on an animal infected with the trypanosoma of the "Abyssinian fly disease."

February 4, 1904. The trypanosomes appeared in the blood to-day for the first time since the feeding commenced.

The following chart shows the course of the disease :—





The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
Feb. 11	...	+	+
,, 18	...	+	+
,, 25	...	+	+
Mch. 4	...	+	+
,, 11	...	+	+
,, 18	...	+	+
,, 24	...	+	+
April 7	...	+	+

April 9. Animal dying. Killed by chloroform.

A slight general enlargement of superficial lymphatic glands. There is no increase of pericardial or pleural fluid.

Brain and Spinal Cord.—No noteworthy change naked eye. Preserved entire for minute investigation.

Heart.—Shows no noteworthy change.

Lungs.—Both healthy.

Liver.—Healthy.

Spleen.—Enlarged and congested

Kidneys.—Both healthy.

Intestine.—An exudation of thick lymph is seen surrounding the rectum, which is adherent to the vagina. The rectum shows a small perforation at its upper part.

Glands.—A drop of juice examined microscopically shows actively motile trypanosomes.

Remarks.—This experiment had already fulfilled its primary object, viz., to ascertain whether *Glossina palpalis* conveyed the trypanosoma of the "Abyssinian Fly Disease" after an interval of 24 hours, and it showed that it could do so This is of importance both from the fact that this variety of trypanosome is capable of transmission by the *Glossina palpalis* and also that *Glossina palpalis* is able to convey not only the Trypanosoma gambiense, but other varieties of trypanosomes. The perforation of the rectum, which was caused by the passage of a thermometer, undoubtedly hastened the death.

C. *Experiments on the effect on Monkeys of the injection of blood containing Trypanosomes from animals suffering from the "Mule Disease."*

EXPERIMENT 180. MONKEY (*Cercopithecus sp.*).

To note the effects of subcutaneous injection of blood from an animal suffering from the "Mule disease" into a monkey.

September 13, 1903. Injected subcutaneously 20 c.c. blood from Col. Saddler's mule. No trypanosomes could be found even after centrifuging the blood.

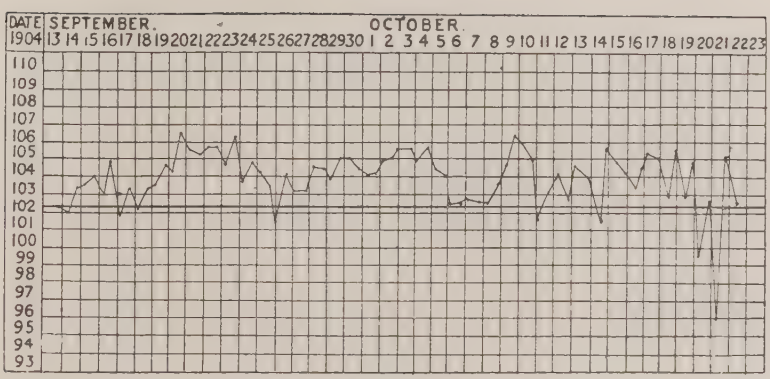
September 20. Trypanosomes appeared in the animal's blood to-day, 7 days after injection.

September 25. The trypanosomes had a peculiar appearance, being crescentic in shape, with a broad thick body and short flagellum. The protoplasm is very vacuolated.

September 28. Some blood removed by opening femoral artery to inject other animals.

October 20. The animal is very sick to-day and is unable to rise. The femoral artery was opened and 5 c.c. blood taken to inject other animals.

The following chart represents the course of the disease:—



The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 14	-	-	-
„ 18	...	-	-
„ 20	...	-	+
„ 22	...	-	+
„ 25	...	-	+
„ 26	...	-	+
„ 28	...	-	+
Oct. 2	...	-	+
„ 3	...	-	+
„ 4	...	-	+
„ 8	...	-	+
„ 10	...	-	+
„ 13	...	-	+
„ 19	...	-	+
„ 20	...	-	+
„ 22	...	-	+

October 23. Animal died. Post-mortem.

The body is considerably emaciated. No enlarged glands. No œdematous swellings.

There is some increase of fluid in the pericardial cavity, no increase of fluid in pleural or peritoneal.

Heart.—Nothing noteworthy.

Lungs.—Show slight congestion.

Liver.—Has mottled appearance.

Spleen.—Somewhat enlarged. Examination of the pulp shows trypanosomes, which are considerably modified in appearance.

Kidneys.—Appear healthy.

Brain.—Was removed entire for further investigation.

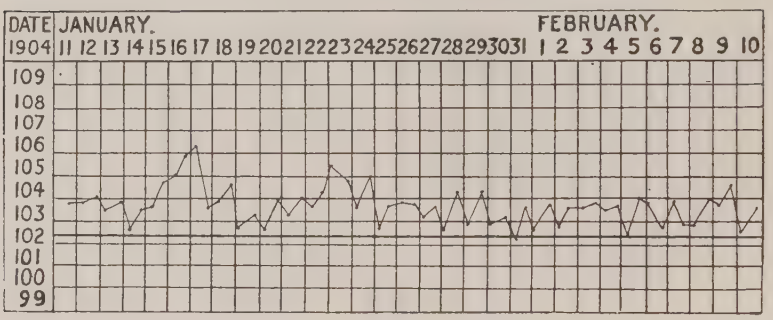
EXPERIMENT 276. MONKEY (*Cercopithecus sp.*).

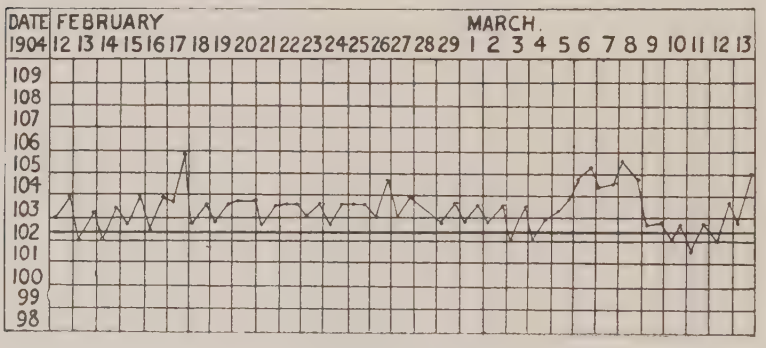
To note the effect of subcutaneous injection of blood from an animal suffering from the "Mule disease" into a monkey.

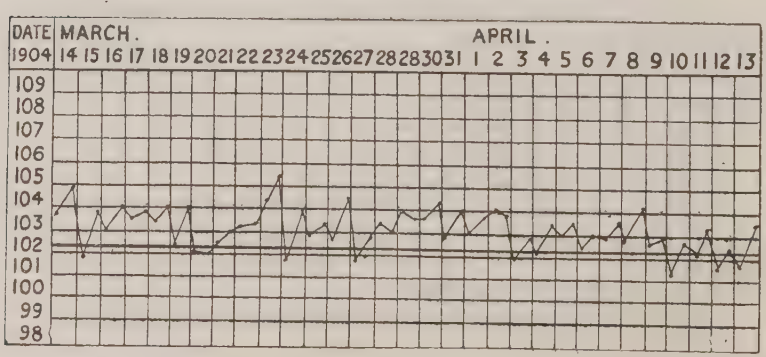
January 11, 1904. Injected 0·75 c.c. of blood subcutaneously from guinea-pig, Experiment No. 182.

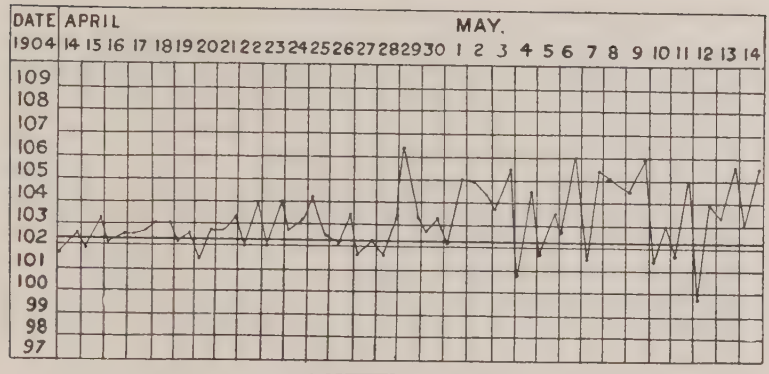
May 11. Animal has been getting very thin and out of condition.

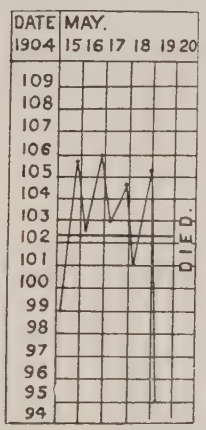
The following chart shows the course of the disease:—











The following table shows the presence or absence of trypanosomes in the blood :—

Date.				Parasites in the blood.		
				Filaria.	Malaria.	Trypanosoma.
	1904.					
Jan.	15	...	...	−	+	+
,,	20	...	...	...	+	+
,,	28	...	...	...	+	+
Feb.	4	...	...	...	+	+
,,	18	...	...	...	+	+
,,	25	...	...	...	+	+
March	4	...	...	...	+	+
,,	11	...	...	...	+	+
,,	18	...	...	...	−	+
,,	24	...	...	...	−	+
April	7	...	...	...	+	+
	14	...	...	...	−	+
,	22	...	...	...	+	+
,,	29	...	...	...	+	+
May	6	...	...	...	+	+
,,	12	...	...	...	+	+
,	20	...	...	...	+	+

May 20. Animal died. Post-mortem.

The body is markedly emaciated. General enlargement of superficial lymphatic glands. No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Normal.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Enlarged and firm on section.

Kidneys.—Both healthy.

Intestines.—Some recent lymph round the rectum and hepatic flexure of colon.

Lymphatic Glands.—In omentum and along great vessels are distinctly enlarged.

Brain.—Naked eye shows no noteworthy change.

Remarks.—This experiment shows the course of this disease in a monkey. Possibly the local peritonitis, caused by damage to rectum by thermometer, helped the fatal issue.

Experiments on the effect of the injection of these Trypanosomes into Dogs.

The native dog of Uganda, on account of the frequency with which anchylostomiasis occurs amongst them, is not suitable as an experimental animal.

However, it was possible to determine that the dog is susceptible to all these "strains" of trypanosomes. The disease caused by them in dogs is invariably fatal. Amongst the signs met with during life are opacity of the cornea, emaciation, anæmia and fever. Œdematous swellings were not present. The lymphatic glands were occasionally enlarged, but not markedly so.

Injection of blood containing Trypanosomes from animals suffering from the "Jinja Cattle Disease" into Dogs.

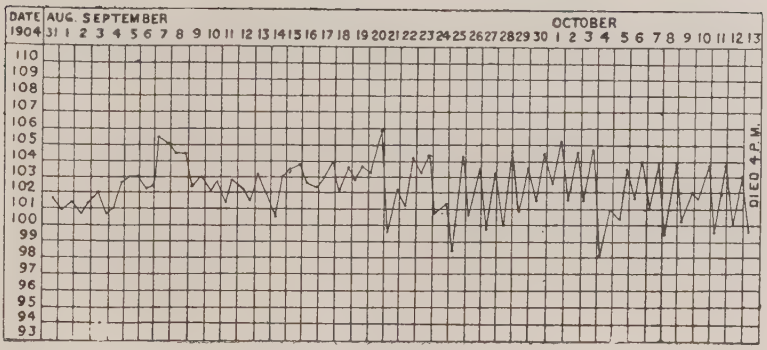
Experiment 164. Dog.

August 31, 1903. Injected 0·5 c.c. blood subcutaneously from Monkey 135, in whose blood the trypanosoma of the "Jinja cattle disease" was present.

September 13. The animal is noticed to be getting thin.

October 2. The animal is now very emaciated. The blood is pale and watery.

The following chart represents the course of the disease :—



The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
August 31	–	...	–
Sept. 3	–	...	–
„ 5	...	...	+
„ 6	...	...	+
„ 7	...	...	+
„ 8	...	...	+
„ 9	...	...	+
„ 12	...	...	+
„ 14	...	...	+
„ 16	...	...	+
„ 17	...	...	+
„ 21	...	...	+
„ 23	...	...	+
„ 26	...	...	+
„ 29	...	...	+
October 2	...	...	+
„ 5	...	...	+
„ 9	...	...	+
„ 10	...	...	+
„ 13	...	...	+

October 13. Animal died at 4 p.m. Post-mortem.

There is marked emaciation. A slight opacity of right cornea. No œdema present. No increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—Many petechiæ and ecchymoses on the anterior surface of the right ventricle. None observed under endocardium.

Lungs.—Both show numerous embolic areas. The microscopic examination of these areas shows trypanosomes variously altered from the typical appearance. Some are circular with a larger and smaller chromatin dot.

Liver.—Has a mottled appearance, probably fatty.

Spleen.—Is distinctly enlarged, measuring 10 in. × 3 in. On section it is fairly firm.

Kidneys.—Both are healthy.

Lymphatic glands.—A few are enlarged and congested in the posterior triangle of neck, also in the mesentery; these on section are seen to be hæmorrhagic.

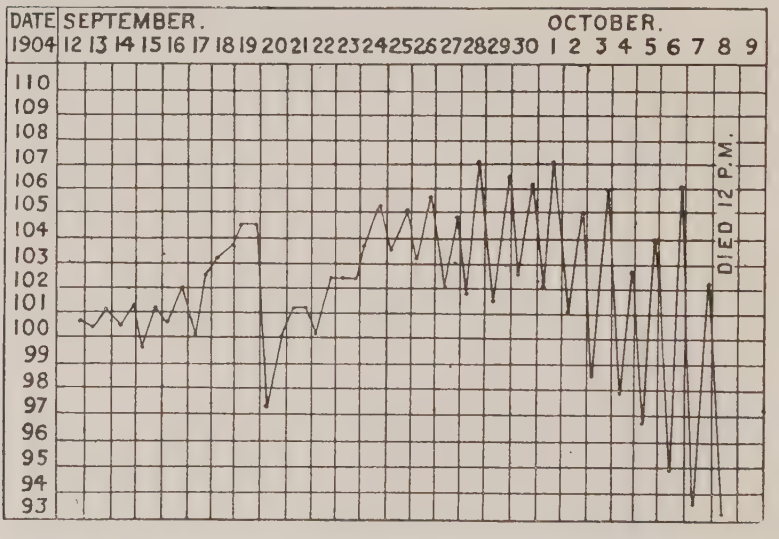
Experiment 178. Dog.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a dog.

September 12, 1903. Injected subcutaneously 0·5 c.c. blood containing trypanosomes from Experiment 164.

October 8. The animal has got thinner lately and is becoming markedly anæmic.

The following chart shows the course of the disease :—



The following table shows the percentage of hæmoglobin and the presence or absence of trypanosomes :—

Date.	Hæmoglobin.	Parasites in the blood.		
		Filaria.	Malaria.	Tryp.
1903.	Per cent.			
Sept. 12	...	–	–	–
„ 15	...	–	–	–
„ 17	...	–	–	+
„ 21	78	–	–	+
„ 23	60	–	–	+
„ 26	50	–	–	+
„ 29	35	–	–	
October 2	28	–	–	–
„ 5	18	–	–	–
„ 8	...	–	–	+

October 8. Animal died at 12.30 p.m. Post-mortem at once.

The body is emaciated. No enlarged superficial glands or œdema. No increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—Muscle is pale, no petechiæ. The blood of this organ contains active trypanosomes.

Lungs.—Nothing noteworthy.

Liver.—Apparently healthy.

Spleen.—Is enlarged about 9 inches × 2 inches.

Kidneys.—Both very pale.

Stomach.—Shows Spiroptera sanguinolenta in the wall.

Intestines.—Contain ankylostomes and tapeworm.

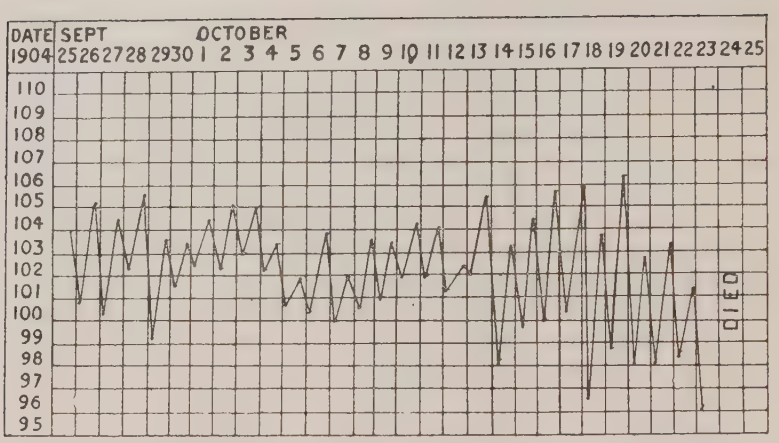
Remarks.—The fatal termination of this experiment was undoubtedly due to the ankylostomiasis.

Experiment 200. Dog.

To note the effect of subcutaneous injection of blood from animal suffering from the "Jinja cattle disease" into a dog.

September 25, 1903. Injected subcutaneously 4 c.c. blood from Monkey 135, containing active trypanosomes.

The following chart shows the course of the disease :—



The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 26	−	−	−
„ 29	...	...	−
Oct. 2	...	...	+
„ 5	...	...	+
„ 8	...	...	+
„ 12	...	...	+
„ 15	...	...	+
„ 19	...	...	+
„ 24	...	...	+

October 24. Died. Post-mortem.

The body is emaciated. There is no opacity of corneæ. Some increase of fluid in pericardial cavity seen, no increase of fluid in pleural or peritoneal cavities.

Heart.—Shows many petechiæ under epicardium of the left ventricle. Also petechiæ under endocardium of each ventricle. The blood of this organ contained active trypanosomes.

Lungs.—Very congested, the right shows many embolic areas. Examined microscopically these areas are seen to contain some enlarged and vacuolated trypanosomes, and many are unaltered.

Liver.—Normal.

Spleen.—Enlarged, measures 8 inches × 2 inches. On the surface towards its posterior end are two tumours, about the size

of a bean. The interior is distinctly congested and they are apparently encapsuled. Films were made and showed trypanosomes of normal appearance. On section of spleen a similar tumour was seen not protruding beyond the surface.

Kidneys.—Pale, otherwise nothing noteworthy.

Intestines.—Contain tape-worms and anchylostomes.

Glands.—Retroperitoneal are enlarged.

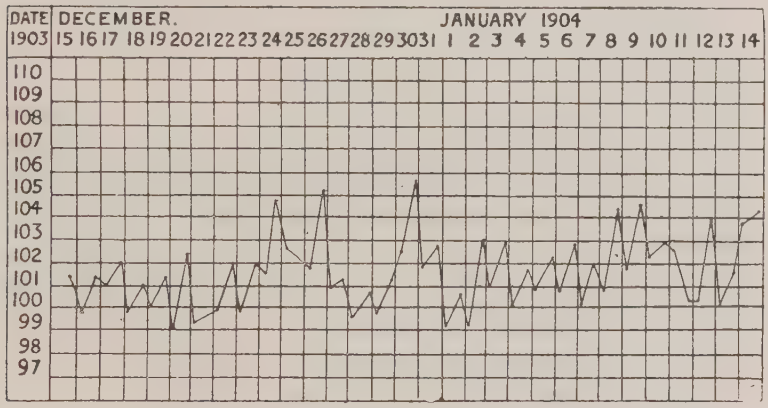
Experiment 269. Dog.

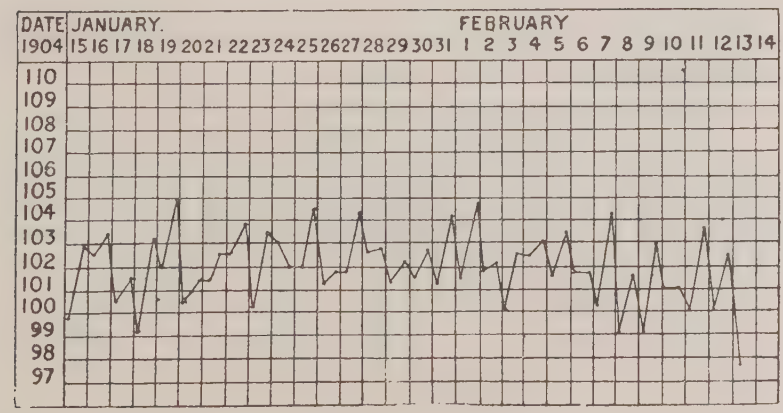
To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a dog.

December 15, 1903. Injected subcutaneously 8 c.c. of blood from goat, Experiment 192.

February 2, 1904. Animal has now got well-marked corneal opacity in both eyes.

The following chart shows the course of the disease:—





The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Dec. 21	–	–	–
, 26	...	...	+
„ 29	...	...	+
1904.			
Jan. 6	...	...	+
„ 12	...	...	+
„ 19	...	...	+
„ 26	...	...	+
Feb. 2	...	...	+
„ 9	...	...	+

February 15. Animal died last night. Post-mortem.

The body is markedly emaciated and both corneæ are quite opaque. The glands are not enlarged.

No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—No petechiæ, a jelly-like material round base. The blood from this organ shows a number of altered trypanosomes.

Lungs.—The right shows a few areas of hæmorrhage, the left shows nothing noteworthy.

Liver.—No noteworthy change.

Spleen.—Slightly enlarged and soft on section.

Kidneys.—Nothing noteworthy.

Intestines.—A few anchylostamata are present in upper part of small intestine.

Lymphatic glands.—Not enlarged.

Remarks.—The blood of the goat with which the animal was injected did not show trypanosomes in films at the time of injection, but still proved capable of infecting the dog. The general course of the disease presented the usual characters of the disease as met with in dogs.

B. *Injection of blood containing Trypanosomes from animals suffering from the Abyssinian Fly Disease into Dogs.*

EXPERIMENT 160. DOG, LARGE.

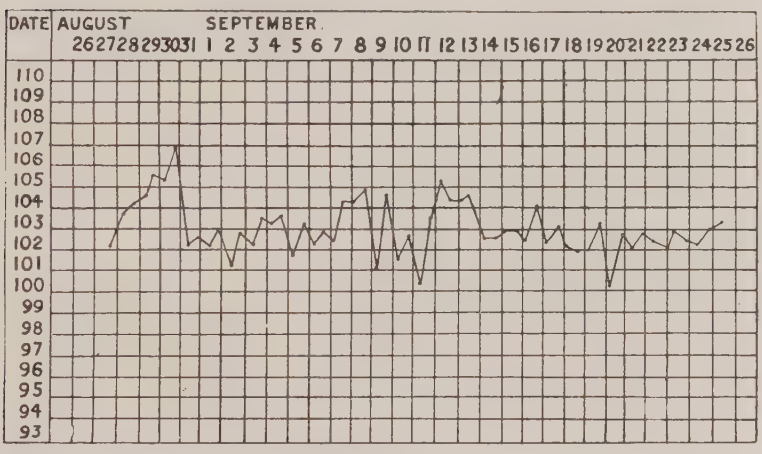
To observe the course of the "Abyssinian fly disease" in a dog.

August 26, 1903. This dog was received to-day from East Africa. It had become sick whilst with the Boundary Commission on the Abyssinian Frontier.

August 27. Blood examined shows many trypanosomes. Animal is thin. Both the corneæ are opaque.

September 7. The animal is getting thinner. There is no œdema of the belly or sheath.

The following chart represents the temperature curve:—



The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Aug. 27	–	–	+
„ 28	...	...	+
„ 30	...	...	+
Sept. 1	...	...	–
„ 2	...	...	–

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 3	...	...	−
„ 4	...	...	+
„ 6	...	...	+
„ 7	...	...	+
„ 12	...	...	+
„ 13	...	...	+
„ 17	...	...	−
„ 18	...	...	−
„ 19	...	...	+
„ 22	...	...	+
„ 23	...	...	+
„ 24	...	...	+

September 25, died. Post-mortem 12 hours after death.

The body is much emaciated. Both corneæ opaque. No enlargement of superficial glands. No œdema.

On opening the body there is no increase of fluid in pleural, pericardial or peritoneal cavities.

Heart.—Nothing noteworthy.

Lungs.—Both show small embolic areas.

Spleen.—Markedly enlarged, 12 inches by $2\frac{1}{2}$ inches; on section the substance is soft.

Liver.—Nothing noteworthy.

Kidneys.—Both normal.

Glands.—Mesenteric and retroperitoneal are enlarged.

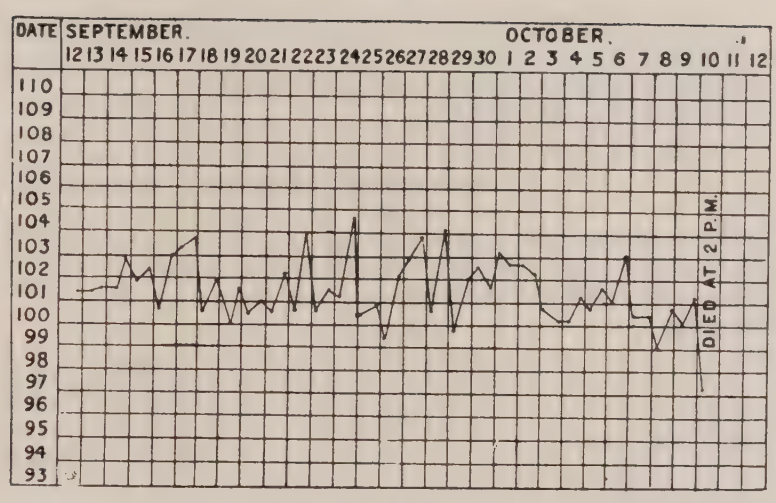
Experiment 177. Dog.

To note the effects of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a dog.

September 12, 1903. Injected subcutaneously 1 c.c. blood from Experiment 160, whose blood contained many trypanosomes.

October 2. The animal is getting thin. The eyes are normal. No œdematous swellings.

The following chart represents the course of the disease :—



The following shows the presence or absence of trypanosomes in the blood:—

Date.	Hb. per cent.	Parasites in the blood.		
		Filar.	Malar.	Tryp.
1903.				
Sept. 12...	...	–	–	–
„ 15...	...	–	–	+
„ 19...	...	–	–	+
„ 21...	78	–	–	+
„ 23...	68	–	–	+
„ 26...	58	–	–	+
„ 29...	59	–	–	+
Oct. 2...	45	–	–	+
„ 5...	50	–	–	+
„ 9...	38	–	–	+

October 10. Animal died at 2 p.m. Post-mortem 1½ hours after death.

The body is fairly well nourished. There is no œdema. No haziness of corneæ. No increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—Shows extensive ecchymosis over left ventricle. There are petechiæ under endocardium of both ventricles. The blood of this organ contains actively motile trypanosomes.

Lungs.—Show many small hæmorrhagic areas. The blood from these areas examined under the microscope shows a number of round bodies about the size of a red corpuscle—these stain blue by Leishman's method and contain one large red dot and several smaller ones.

Liver.—Appears healthy.

Spleen.—Considerably enlarged, about 9 inches by 2 inches. On section the pulp is soft.

Kidneys.—Pale, capsule is adherent in places.

Glands.—Are not enlarged.

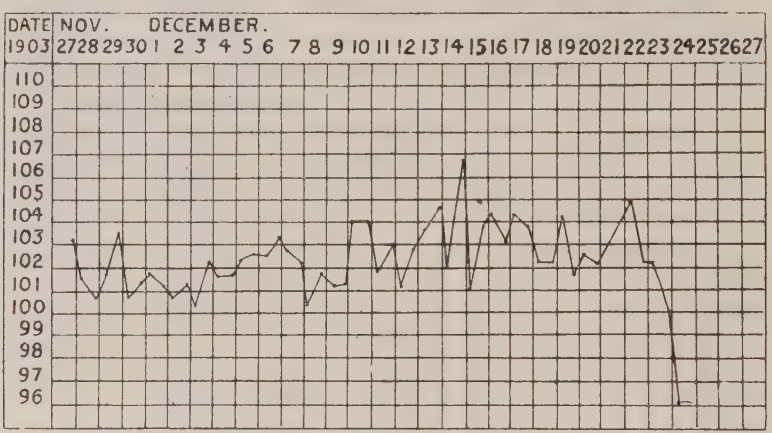
Experiment 260. Dog.

To note the effect of injection of blood from an ox suffering from the "Abyssinian fly disease," in whose blood the trypanosome was not observed on microscopic examination, into a dog.

November 27, 1903. Injected 20 c.c. of blood subcutaneously from Ox 209, which had not shown trypanosomes in its blood.

December 1. Blood was examined and a filaria, probably *F. imitis*, was observed.

The following chart shows the course of disease :—



The following table shows the presence or absence of filariæ and trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
1903.			
Nov. 30	−	−	−
Dec. 1	+	...	−
„ 5	...	...	−
„ 7	...	...	−
„ 8	...	...	+
„ 15	+	...	+
„ 21	+	...	+
„ 24	...	...	+

December 24. Animal died. No post-mortem.

Remarks.—This experiment is of interest as showing that although the ox never showed trypanosomes in the blood on microscopic examination, yet when the blood of this animal was injected into a dog it at once produced the disease, showing that the injection of the trypanosomes into the ox had actually taken and the animal was only partially immune.

C. *Injection of blood containing trypanosomes from animals suffering from the Mule disease into dogs.*

EXPERIMENT 167. DOG.

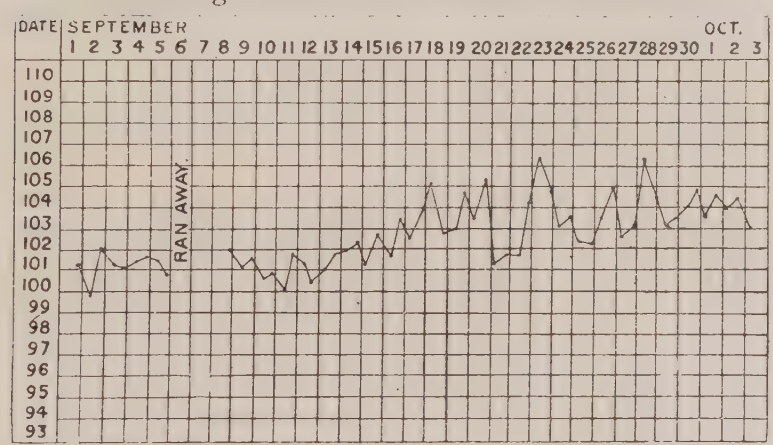
To note the effects of subcutaneous injection of blood from the "Mule Disease" into dog.

September 9, 1903. Injected 18 c.c. of blood from Colonel Sadler's mule subcutaneously.

September 17. The trypanosomes appeared in the blood to-day for the first time, 8 days after inoculation.

October 2. The animal keeps in good condition apparently.

The following chart shows the course of the disease:—



The following table shows the presence or absence of trypanosomes in the blood.

Date.	Hæmoglobin per cent.	Parasites in blood.		
		Filar.	Malar.	Tryp.
1903.				
Sept. 1	...	–	–	–
„ 12	...	...	...	–
„ 14	...	...	...	–
„ 17	...	...	...	+
„ 19	...	...	...	+

Date.	Hæmoglobin per cent.	Parasites in blood.		
		Filar.	Malar.	Tryp.
1903.				
Sept. 21	95	...	...	+
„ 23	65	...	...	+
„ 26	60	...	...	+
„ 29	60	...	...	+
Oct. 2	59	...	...	+
„ 5	...	...	...	+

October 2. Animal died at 9 a.m. Post-mortem.

The body is well nourished. No opacity of the corneæ. There is no œdema. The lymphatic glands in both axillæ are enlarged.

There is no increase of fluid in the pleural or pericardial cavities, some increase of peritoneal fluid.

Heart.—No petechiæ present. The muscle substance is pale. The blood from this organ examined microscopically shows active trypanosomes.

Lungs.—Both show areas of embolism.

Liver.—Slightly enlarged and appears fatty.

Spleen.—Is enlarged; measures $10\frac{1}{2}$ inches by $2\frac{1}{2}$ inches. On section the substance is soft.

Kidneys.—Are pale.

Glands.—No enlarged in abdomen.

Remarks.—This experiment illustrates the course which the disease takes in a dog. The animal did not show any eye changes, œdema, or marked emaciation.

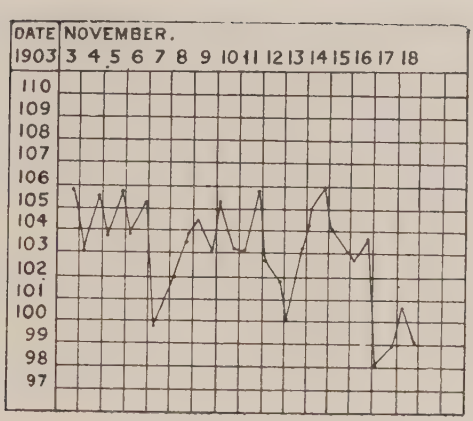
Experiment 240. Jackal.

To observe the course of the "mule disease" in a jackal.

November 3, 1903. During the night of November 1 this animal completely devoured a monkey, 232, suffering from the mule disease.

November 5. Animal is seedy to-day; copious semipurulent discharge from eyes.

The following chart shows the course of the disease :—



The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Nov. 3	–	–	+
„ 8	...	...	+
„ 9	...	...	+
„ 17	...	...	+

November 18. Died at noon. Post-mortem.

No noteworthy external appearances.

No increase of fluid in pleural, pericardial or peritoneal cavities.

Heart.—There is some jelly-like material at base. Some petechiæ under endocardium of right ventricle.

Lungs.—Right shows two areas of infarction in lower lobe. Both show small round embolic areas.

Liver.—Healthy.

Spleen.—Considerably enlarged, 8 inches by $2\frac{1}{2}$ inches.

Smears from the substance show the presence of a few trypanosomes.

Kidneys.—Both healthy.

Intestines.—Contain a considerable number of anchylostomata.

Remarks.—This experiment illustrates the course of the disease in a jackal.

On the effect of the injection of these Trypanosomes into Baboons, Rabbits, Guinea Pigs, Donkeys and Rats.

Experiment 220a. Dog-faced Baboon.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a baboon.

June 11, 1904. Experiment 220 having remained negative, 5 c.c. of blood from Experiment 278, suffering from "Jinja cattle disease," was injected.

Trypanosomes never appeared in the blood of this animal.

Remarks.—This experiment shows that the baboon is insusceptible to this variety of trypanosome also.

Experiment 220. Dog-faced Baboon.

To note the effect of subcutaneous injection of blood containing trypanosomes from an animal suffering from the "Abyssinian fly disease" into a baboon.

October 8, 1903. Injected 3 c.c. of blood from Dog 177, containing active trypanosomes.

Trypanosomes never appeared in the blood of this animal.

Remarks.—This experiment demonstrates that the dog-faced baboon is insusceptible to this variety of trypanosome.

Experiment 231. Dog-faced Baboon.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Mule disease" into a baboon.

October 13, 1903. Injected subcutaneously 8 c.c. of blood from Dog 197.

November 8. Re-injected subcutaneously with 7 c.c. of blood from Jackal 240.

January 19, 1904. Trypanosomes not having appeared in the blood 0·5, c.c. of blood injected subcutaneously from Guinea Pig 182, in whose blood many trypanosomes were present.

Trypanosomes never appeared in the blood of this animal; the temperature remained normal throughout.

Remarks.—This experiment shows that the baboon is not susceptible to this variety of trypanosome also. The baboon is thus immune to all the varieties experimented with.

Experiment 185. Guinea Pig.

To note the effects of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" with a guinea pig.

September 16, 1903. Injected subcutaneously 1 c.c. blood from Dog 164, containing trypanosomes.

October 15. Trypanosomes appeared in the blood to-day for the first time, twenty-nine days after injection.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.		Temperature.	Parasites in the blood.		
			Filaria.	Malar.	Tryp.
1903.					
Sept.	16	...	–	–	–
,,	18	...	...	...	–
,,	20	...	...	...	–
,,	22	104°	...	...	–
,,	24	102·2°	...	...	–
,,	26	103°	...	...	–
,,	28	...	...	...	–
October	1	...	...	...	–
,,	4	...	...	...	–
,,	6	...	...	...	–
,,	8	...	...	...	–
,,	11	...	...	...	–
,,	15	...	...	...	+
	19	...	...	...	–
,,	26	...	...	...	+
Nov.	3	...	...	...	+
,,	10	...	...	...	+
,,	17	...	...	...	+
,,	24	...	...	...	+

November 25. Animal died in night. Post-mortem.

The body is not markedly emaciated—a sore over the right hip. No œdematous swellings. The superficial glands are enlarged. No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Under the epicardium of right ventricle petechiæ are present.

Lungs.—Both normal.

Liver.—Nothing noteworthy.

Spleen.—Markedly enlarged and soft on section.

Kidneys.—Both are normal.

Remarks.—Before death the number of trypanosomes present in the blood increased considerably. The disease ran a chronic course in this animal.

Experiment 316. Guinea Pig.

To note the effect of subcutaneous injection of blood from an animal suffering from the Jinja cattle disease into a guinea pig.

August 25, 1904. Injected subcutaneously 2 c.c. of blood containing many trypanosomes from Experiment 289.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
August 25	...	–	–
„ 30	...	...	–
Sept. 6	...	...	–
„ 13	...	...	–
„ 27	...	...	–
Oct. 4	...	...	+

Experiment 221. Guinea Pig.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a guinea pig.

October 8, 1903. Injected subcutaneously 2 c.c. blood from Dog 177, containing active trypanosomes.

December 24, 1903. The trypanosomes not having appeared in the blood, 1 c.c. of blood from Dog 260 was injected subcutaneously.

January 26, 1904. The trypanosomes appeared in the blood to-day for the first time, the thirty-fourth day after the second injection.

August 16, 1904. The animal has an œdematous swelling of the left ear and side of face. It is somewhat emaciated.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.		Parasites in the blood.		
		Fil.	Mal.	Tryp.
1903.				
Oct. 8 ...	Injected 2 c.c. blood from D. 177 ...	–	–	–
„ 9 ...	... ...	...	...	–
„ 15 ...	... ...	...	...	–
„ 20 ...	... ...	...	...	–
„ 26 ...	... ...	...	...	–
„ 30 ...	... ...	...	...	–
Nov. 3 ...	... ...	...	...	–

Date.		Parasites in the blood.		
		Fil.	Mal.	Tryp.
1903.				
Nov. 10	...	...	...	−
„ 17	...	...	...	−
„ 24	...	...	...	−
„ 29	...	...	...	−
Dec. 1	...	...	...	−
„ 8	...	...	...	−
„ 15	...	...	...	−
„ 22	...	...	...	−
„ 24	... Injected 1 c.c. blood from D. 260...	...	...	−
„ 29	...	...	...	−
				−
1904.				
Jan. 6	...	...	...	
„ 12	...	...	...	−
„ 19	...	...	...	−
„ 26	...	...	...	+
Feb. 2	...	...	...	+
„ 9	...	...	...	+
„ 16	...	...	...	+

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
Feb. 23	...	...	+
Mar. 8	...	...	+
„ 15	...	...	−
„ 22	...	...	−
„ 28	...	...	−
April 5	...	...	−
„ 12	...	...	−
„ 19	...	...	−
„ 26	...	...	+
May 3	...	...	+
„ 10	...	...	+
„ 17	...	...	−
„ 31	...	...	−
June 14	...	...	−
„ 21	...	...	+
„ 28	...	...	+
July 12	...	...	+
„ 19	...	...	+
„ 26	...	...	+
Aug. 4	...	...	+
„ 9	...	...	+
„ 16	...	...	−
„ 23	...	...	+
„ 30	...	...	+
Sept. 6	...	...	+
„ 13	...	...	+
„ 15	...	...	+

September 15, 1904. Animal died. Post-mortem.

The body is somewhat emaciated. There is some œdematous swelling about the face. No opacity of corneæ. The superficial glands are generally enlarged. The coat is not out of condition.

No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Shows nothing noteworthy. The blood of this organ does not contain active trypanosomes, but a few are seen on staining.

Lungs.—Right shows an area of hæmorrhage, smears made from this area show altered trypanosomes; left lung nothing noteworthy.

Liver.—Somewhat congested.

Spleen.—Somewhat enlarged and rather soft on section. Smears from the spleen show altered trypanosomes.

Kidneys.—Nothing noteworthy.

Stomach and Intestines.—Healthy.

Lymphatic glands.—Show general enlargement.

Remarks.—The course of the disease in this animal was remarkably chronic, its duration being nearly a year. The trypanosomes were present in the peripheral blood throughout with the exception of occasional intermissions.

Experiment 182. Guinea Pig.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Mule disease" into a guinea pig.

September 13, 1903. Injected 10 c.c. of blood subcutaneously from Mule 179.

November 9. The trypanosomes not having appeared in the blood of this animal, it was reinjected subcutaneously with 5 c.c. of blood from Jackal 240.

November 10. There is some induration at site of inoculation; opened, and necrotic tissue removed.

November 17. Some sloughing of tissue over site of inoculation has occurred.

November 22. Trypanosomes appeared in the blood to-day for the first time, one hundred and ten days after first inoculation, and forty-three days after second.

February 2, 1904. Since their appearance in the blood the trypanosomes have become very numerous and have shown peculiar forms; several of these are represented in the coloured plate.

The temperature remained normal throughout.

The following table shows the presence or absence of trypanosomes in the blood:—

BLOOD OF GUINEA PIG.

MULE VARIETY OF TRYPANOSOME.

1375 8/05. H & S 7390.
6

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 15	–	–	–
„ 18	...	...	–
„ 20	...	...	
„ 22	...	...	–
„ 24	...	...	
„ 26	...	...	–
„ 28	...	...	–
Oct. 1	...	...	–
„ 4	...	...	–
„ 6	...	...	–
„ 8	...	...	–
„ 10	...	...	–
„ 15	...	...	–
„ 19	...	...	–
„ 26	...	...	–
„ 30	...	...	–
Nov. 3	...	...	–
„ 9	...	...	–
„ 10	...	...	–
„ 17	...	...	–
„ 24	...	...	–
Dec. 1	...	...	–
„ 8	...	...	–
„ 15	...	...	–
„ 22	...	...	+
„ 29	...	...	+
1904.			
Jan. 6	...	...	+
„ 11	...	...	+
„ 12	...	...	+
„ 19	...	...	+
„ 26	...	...	+
Feb. 2	...	...	+
„ 9	...	...	+
„ 14	...	...	+

February 14, 1904. Animal died in the night. Post-mortem.

The body is not emaciated.

There is no increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—Shows an extensive area of hæmorrhage over left ventricle—small point of hæmorrhage under endocardium of left ventricle. The blood of this organ shows very few trypanosomes.

Lungs.—Left shows an extensive area of hæmorrhage under pleura over lower lobe. Right shows a number of minute embolic areas scattered through it.

Liver.—Nothing noteworthy.

Spleen.—Distinctly enlarged, and on section showed a

number of greyish sago grain-like points. Examination of the pulp showed trypanosomes, but most of them were considerably modified from the normal appearance.

Kidneys.—Right showed small area of infarction; left nothing noteworthy.

Glands.—A few retroperitoneal were enlarged.

Remarks.—This experiment illustrates the course of this disease in the guinea pig. The most noteworthy points were the long duration of the disease, the very slight manifestations clinically, the late appearance of the trypanosomes in the peripheral blood, the large number of parasites present and their peculiar forms.

Experiment 289. Rabbit, Young.

To note the effect of subcutaneous injection of blood from an animal suffering from the Jinja cattle disease into a rabbit.

May 6, 1904. Injected subcutaneously 1 c.c. of blood containing many trypanosomes from monkey, Experiment 263.

May 17. Trypanosomes are present in the blood eleven days after inoculation.

August 23. Animal has got opacity of both corneæ.

The fur is shed in places and the coat is much out of condition. The animal is considerably emaciated.

The temperature remained about normal until August 25, 1904 (the day of its death) when it fell 93·5°.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
May 10	–	–	–
„ 17	...	–	+
„ 31	...	...	+
June 14	...	...	+
„ 22	...	...	+
„ 28	...	...	+
July 12	...	...	+
„ 19	...	...	+
„ 26	...	...	+
Aug. 2	...	...	+
„ 9	...	...	+
„ 16	...	...	+
„ 23	...	...	+
„ 25	...	...	+

August 25, 1904. Animal died to-day. Post-mortem at once.

The body is emaciated. Both corneæ are opaque. The coat is much out of condition. The lymphatic glands are not enlarged.

There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—Nothing noteworthy. The blood of this organ contains many active trypanosomes.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Not enlarged.

Lymphatic glands.—Not enlarged.

Remarks.—This experiment demonstrates the course of this disease in a rabbit. It runs a somewhat chronic course. The animal, however, shows very marked signs of deterioration of health.

Experiment 295. Rabbit.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Mule disease" into a rabbit.

May 20, 1904. Injected subcutaneously 5 c.c. of blood from Monkey 276 into this rabbit.

August 16. Trypanosomes are present in the blood of this animal to-day, fifty-seventh day after injection.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1904.			
May 31	...	–	–
June 14	...	...	–
„ 21	...	...	–
„ 28	...	...	–
July 12	...	...	–
„ 19	...	...	–
„ 26	...	...	–
Aug. 2	...	...	–
„ 9	...	...	–
„ 16	...	...	+
„ 23	...	...	+
„ 30	...	...	–
Sept. 6	...	...	–
„ 13	...	...	–

Experiment 179. Colonel Sadler's Mule.

September 9, 1903. This animal has been sick since July 3, 1903. It has been in Africa about five years; at first it was in East Africa, and for the last eighteen months has been in

Uganda. It remained well until recently, when it commenced to have swelling of the glands and fever. It eats well. It is getting thin. There is no swelling of the sheath. The blood was examined and trypanosomes were found to be present.

September 13. Animal was brought up to the laboratory this morning It was very weak and fell down; it never rose again.

The temperature oscillated between 105° and 107°.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
1903.			
Sept. 9	−	−	+
„ 12	...	...	−
„ 13	...	...	−

September 13. Animal died. Post-mortem at once.

The animal is emaciated, no opacity of corneæ—no swelling of sheath, no enlarged superficial glands. There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—No jelly-like material round the base. A few petechiæ under epicardium, also under the endocardium of right ventricle. The heart muscle is pale. The blood is very watery; inoculated into two monkeys, rat and guinea pig; 10 c.c. blood was centrifuged, but no trypanosomes were seen.

Lungs.—Both normal.

Spleen.—Enlarged, weighs about 14 lbs.; somewhat congested.

Kidneys.—Both normal.

Glands.—Not enlarged in mesentery or retroperitoneally.

Remarks.—The above case is of interest as it brought under observation a disease in mules caused by a trypanosoma. The trypanosoma met with in this disease has been fully investigated.

Although no trypanosomes could be seen microscopically on two occasions in the blood of this animal, yet when injected into other animals the trypanosomes appeared in due course.

Experiment 278. Donkey (*Masai*).

To note the effect of subcutaneous injection of blood from an animal suffering from "Jinja cattle disease" into a Masai donkey.

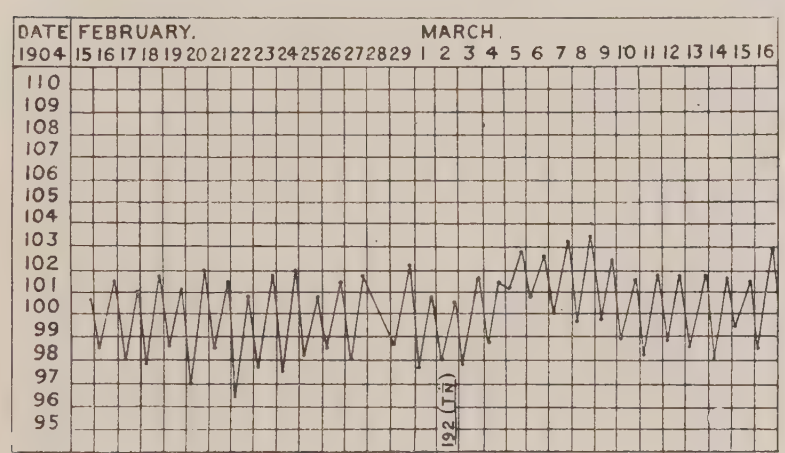
March 2, 1904. Injected subcutaneously 10 c.c. of blood from goat, Experiment 192.

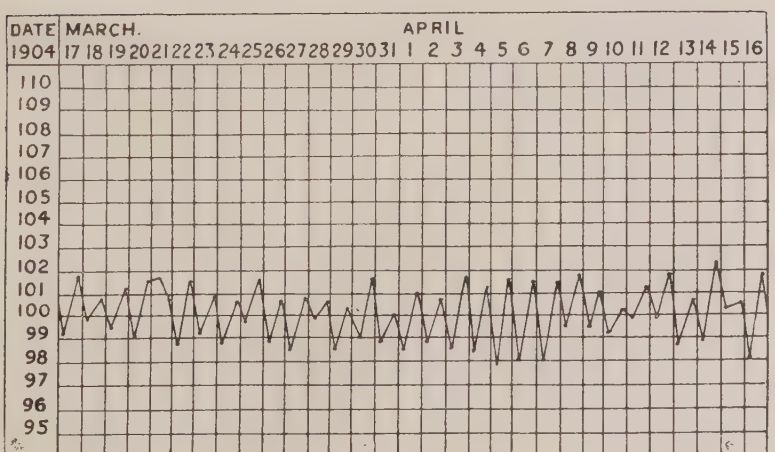
May 6. Trypanosomes not having appeared in the blood, the animal was reinjected with 4 c.c. of blood subcutaneously from Experiment 263, in whose blood at the time of injection there were 38,000 trypanosomes per c.mm.

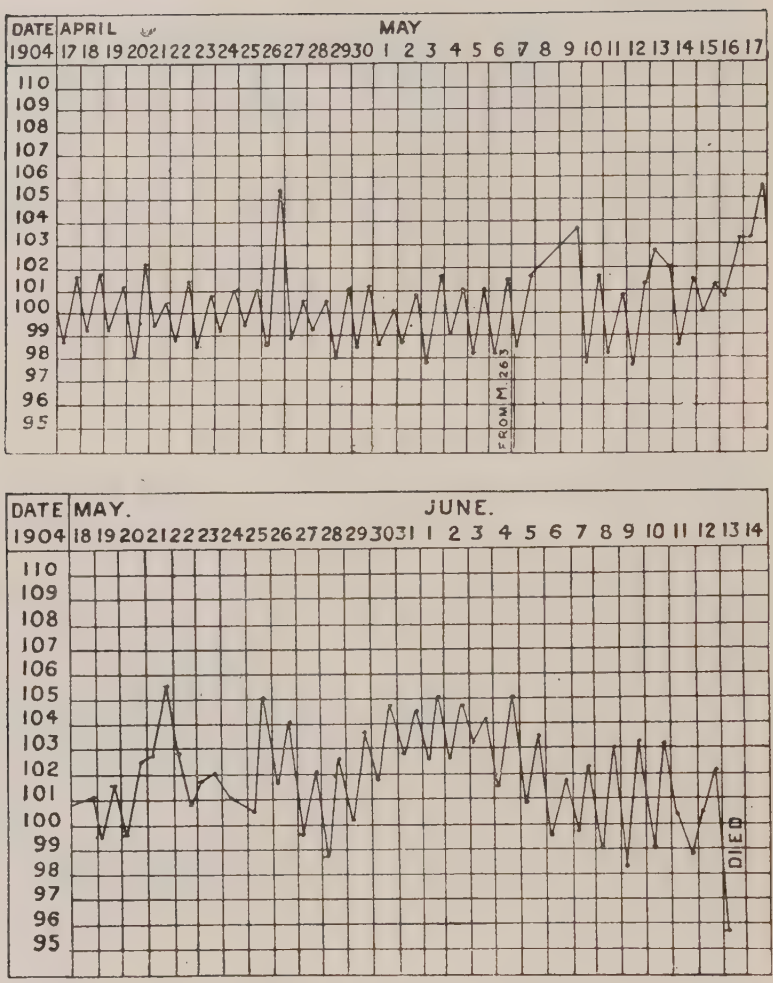
May 18. Trypanosomes appeared in the blood to-day, the thirteenth day after inoculation.

June 11. Animal is very sick and unable to rise. Its coat is rough, conjunctivæ very pale. Breathing is rapid and shallow. No œdematous swellings.

The following chart shows the course of the disease :—







The following table shows the result of enumeration of the blood corpuscles, the percentage of hæmoglobin and the presence or absence of trypanosomes in the blood :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in blood.		
			P.N.	S.M.	L.M.	E.		Filar.	Malar.	Tryp.
1904.										
Feb. 24	...	...	...	...	...	...	...	...	–	–	–
March 9	...	...	...	...	...	...	...	...	...	...	–
„ 16	...	...	...	...	...	...	...	...	...	...	–
„ 23	...	...	...	...	...	...	...	...	...	...	–
„ 30	...	...	...	...	...	...	...	...	...	...	–
April 7	...	...	...	...	...	...	...	...	...	...	–
„ 20	...	...	...	...	...	...	...	...	...	...	–
„ 27	...	...	...	...	...	...	...	...	...	...	–
May 4	...	...	...	...	...	...	...	...	...	...	–
„ 11	...	...	...	...	...	...	...	...	...	...	–
„ 18	...	...	...	...	...	...	...	...	...	...	–
„ 24	...	...	...	...	...	...	...	...	...	...	+
June 1	...	...	...	...	...	...	...	...	...	...	+
„ 8	...	...	...	...	...	...	...	...	...	...	+
„ 11	2,350,000	22,500	72	13	14	1	24	...	...	...	+

June 13. Animal died at 12.30 p.m. Post-mortem at once. The body is not emaciated. No œdematous swellings. No opacity of corneæ. A general enlargement of superficial glands is present. No increase of fluid in pleural, pericardial or peritoneal cavities.

Heart.—There is some jelly-like material round base. Petechiæ under epicardium and endocardium.

Lungs.—Both healthy.

Liver.—Enlarged and congested.

Spleen.—Somewhat enlarged and congested; smears from this organ show broken-down trypanosomes.

Kidneys.—Both healthy.

Intestines.—Healthy.

Glands.—In retroperitoneal region are enlarged. Smears from the glands show the presence of broken-down trypanosomes.

Remarks.—The first injection from the goat did not take in this animal. After the second injection, however, trypanosomes appeared on the 13th day, and he died on the 26th day. The blood examination showed a marked diminution in the number of red corpuscles and hæmoglobin. The duration of the disease after the appearance of the trypanosomes was much shorter than in the case of the other varieties of animal trypanosomes.

Experiment 222. Donkey (*Masai*).

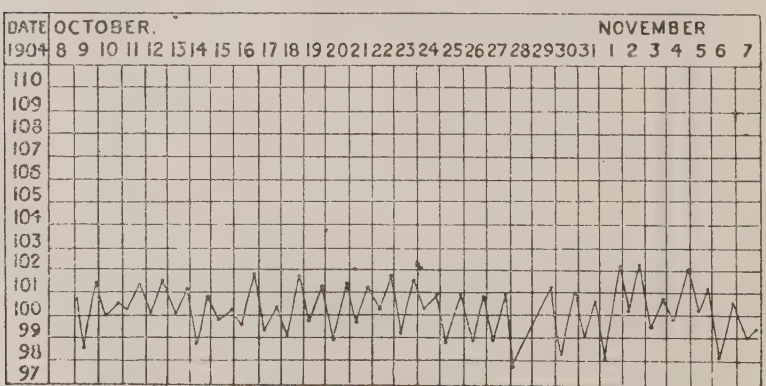
To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a donkey.

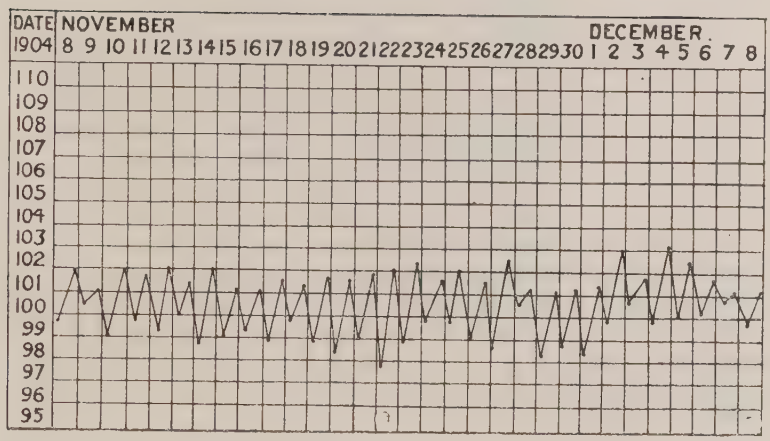
October 8, 1903. Injected 5 c.c. blood from dog, Experiment 177, containing active trypanosomes.

November 23. Trypanosomes not having appeared in the peripheral blood, 10 c.c. of blood was taken and injected into dog, Experiment 256.

December 1. Trypanosomes appeared to-day in the blood of the dog, Experiment 256.

The following chart shows the course of the disease :—




DATE
1904
NOVEMBER
DECEMBER.
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8
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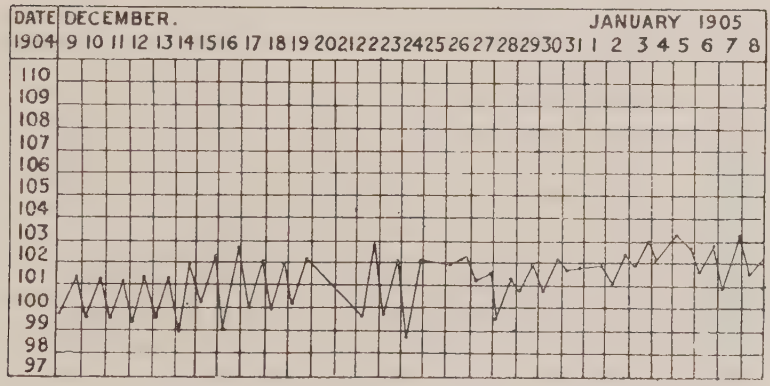
DATE
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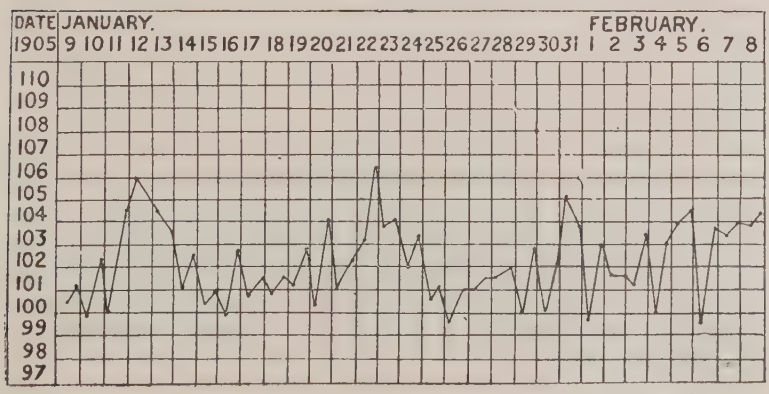
DATE
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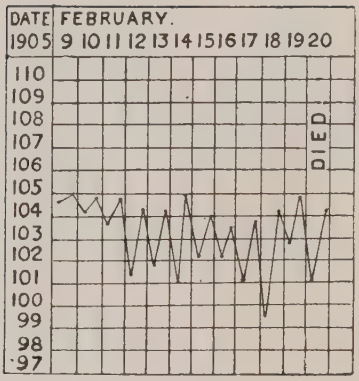


The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
1904.			
Oct. 8	–	–	–
„ 16	...	...	–
„ 21	...	...	–
„ 28	...	...	–
Nov. 4	...	...	–
„ 11	...	...	–
„ 18	...	...	–
„ 25	...	...	–
Dec. 2	...	...	–
„ 9	...	...	–
„ 16	...	...	–
„ 23	...	...	–
„ 30	...	...	–
1905.			
Jan. 7	...	...	–
„ 13	...	...	–
„ 20	...	...	–
„ 27	...	...	–
Feb. 3	...	...	+
„ 9	...	...	–
„ 17	...	...	–
„ 21	...	...	+

February 21. Animal died last night. Post-mortem.

There is no opacity of corneæ. There is slight general enlargement of superficial lymphatic glands. The coat is out of condition, but emaciation is not marked. No œdematous swellings. No increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—A few small petechiæ on surface, also under

endocardium of all the cavities there are numerous petechiæ. There is no jelly-like material at base. Muscle substance is pale.

Lungs.—Vessels are plugged with discoloured clots.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged—firm on section.

Kidneys.—Nothing noteworthy.

Brain.—No noteworthy change, naked eye.

Glands.—Some enlargement of the glands along the great vessels of the neck. Smears made from the glands on staining show trypanosomes apparently breaking down.

Remarks.—This experiment is of considerable interest, as it demonstrates the course of this disease (Abyssinian) in a donkey. As compared with the "mule disease" in the donkey it runs a more chronic course; the trypanosomes were only found once in the peripheral blood, but their presence was demonstrated by injection of a susceptible animal, Dog 256.

Experiment 229. Donkey (*Masai*).

To note the effect of subcutaneous injection of blood from an animal suffering from the "mule disease" into a donkey.

October 13, 1903. Injected 10 c.c. of blood from heart of Dog 197 post-mortem; no active trypanosomes were seen.

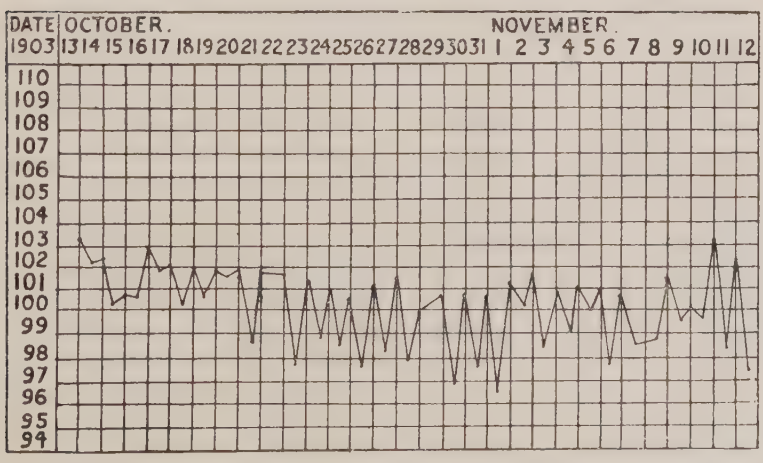
November 9. Injected 5 c.c. of blood from Jackal 240, containing active trypanosomes.

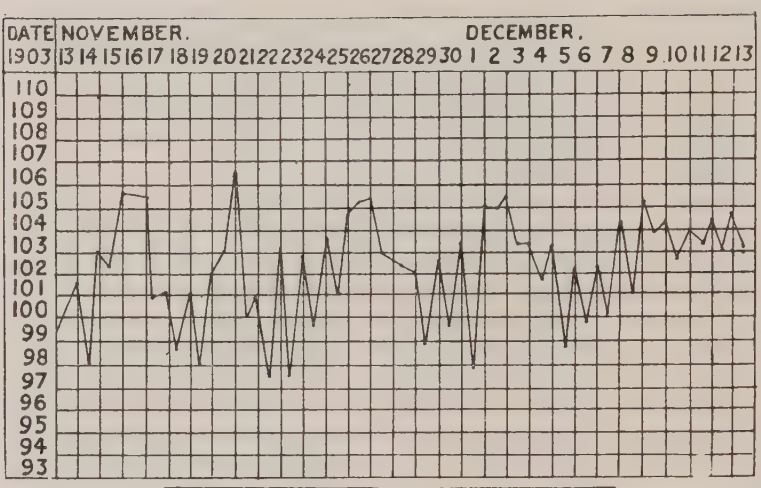
November 25. Trypanosomes appeared in the blood to-day, 16 days after reinjection.

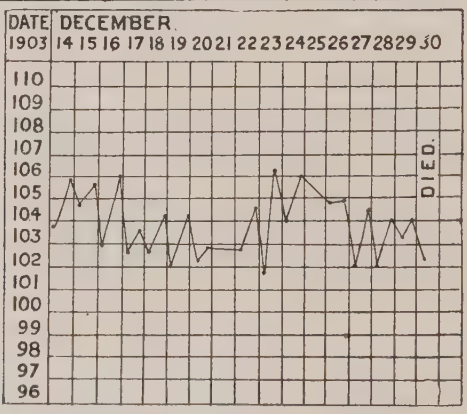
December 26. Animal is distinctly seedy to-day. He is not taking his food. His head is drooping and coat is staring.

December 27. Now disinclined to move from one place. He is not taking his food and looks very ill.

The following chart shows the course of the disease:—







The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Oct. 13	–	–	–
„ 21	...	...	–
„ 28	...	...	–
Nov. 4	...	...	–
„ 11	...	...	–
„ 18	...	...	–
„ 21	...	...	–
„ 22	...	...	–
„ 25	...	...	+
Dec. 2	...	...	+
„ 9	...	...	+
„ 16	...	...	+
„ 23	...	...	+
„ 29	...	...	+

December 30. The animal died at 12 noon to-day. Post-mortem.

The body is not much emaciated. No œdematous swellings. No opacity of corneæ. Conjunctivæ very pale.

No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart.—On opening the pericardium, a red band was seen stretching across the left ventricle; this was composed of an agglomeration of minute petechiæ. A number of other petechiæ were distributed over the surface of the heart. The endocardium shows numerous petechiæ. The myocardium is pale.

Lungs.—Show a few hæmorrhages under the pleural membrane. No infiltration of jelly-like substance.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged, section congested; smears stained show altered trypanosomes.

Kidneys.—Both very pale.

Glands.—Not markedly enlarged. Smears examined after staining show altered trypanosomes.

Brain.—Preserved for minute investigation; showed no naked eye change.

Remarks.—This is a very interesting experiment, proving as it does that the donkey, *although a Masai one*, is not immune, at least to this variety of trypanosome. The animal did not present the normal features met with in Nagana, viz., emaciation, œdematous swelling or opacity of corneæ. This animal was previously repeatedly injected with blood from a case of "trypanosoma fever," but it remained refractory. This experiment, therefore, suggests that the Trypanosoma gambiense differs from this variety of trypanosoma.

Experiment 175. Rat.

To note the effects of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a rat.

September 7, 1903. Injected a few drops of blood from Experiment 164, containing many trypanosomes.

September 12. The trypanosomes appeared in the blood for the first time.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 7	–	–	–
„ 10	...	...	–
„ 12	...	...	+
„ 14	...	..	+

September 14. Animal died. Post-mortem.

Organs showed nothing noteworthy. The blood from the heart contained active trypanosomes.

Experiment 173. Rat.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a rat.

September 7, 1903. Injected 0·5 c.c. blood from Experiment 160, dog, whose blood contained many trypanosomes.

September 10. The trypanosomes appeared in the blood of this animal to-day, the third day after inoculation.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 7	–	–	–
„ 10	...	...	+
„ 12	...	...	+
„ 15	...	...	+

September 17. Animal died. Post-mortem several hours after death.

Heart.—Shows nothing noteworthy. The blood from this organ contained no living trypanosomes.

Lungs.—Left shows slight congestion. Right is healthy.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged.

Kidneys.—Nothing noteworthy.

Remarks.—The disease ran an acute course in this animal, dying ten days after inoculation.

Experiment 190. Rat.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a rat.

September 19, 1903. Injected subcutaneously 2 c.c. blood from dog, Experiment 160.

September 26. The blood was examined and found to contain trypanosomes; seventh day after inoculation.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.	Parasites in the blood.		
	Malaria.	Filaria.	Trypanosoma.
1903.			
Sept. 19	–	–	–
„ 21	...	...	–
„ 22	...	...	–
„ 23	...	...	–
„ 24	...	...	–
„ 26	...	...	+
„ 28	...	...	+
Oct. 2	...	...	+
„ 3	...	...	+

October 3. The animal died. Post-mortem.

There are no œdematous swellings present. There is no increase of fluid in pericardial, pleural or peritoneal cavities.

Heart.—Nothing noteworthy. The blood of this organ contains a few trypanosomes which are somewhat vacuolated in appearance.

Lungs.—Both healthy.

Spleen.—Is enlarged and congested.

Experiment 208. Rat.

To note the effect of subcutaneous injection of blood from an animal suffering from the "mule disease" into a rat.

September 28, 1903. Injected 1·5 c.c. blood from Monkey 180 containing active trypanosomes.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Malaria.	Filaria.	Trypanosoma.
1903.			
Sept. 30	–	–	–
Oct. 1	...	...	+
„ 12	...	...	+
„ 24	...	...	+
Nov. 3	...	...	+
„ 10	...	...	+
„ 17	...	...	+
„ 24	...	...	+
Dec. 1	...	...	+
„ 8	...	...	+
„ 15	...	...	+

December 15, 1903. Animal died. Post-mortem.

No marked emaciation. The superficial glands are not enlarged.

Heart.—Shows hæmorrhages into muscular wall of left ventricle, otherwise healthy. The blood of this organ did not contain active trypanosomes.

Lungs.—Both healthy.

Liver.—Slightly enlarged and very pale.

Spleen.—Distinctly enlarged, pale, soft on section.

Remarks.—This experiment illustrates the fact that the disease may run a remarkably chronic course in rats. The trypanosomes were present in the peripheral blood throughout the disease.

Experiment 187. Rat.

To note the effects of injection of blood from an animal suffering from the "mule disease" into a rat.

September 19, 1903. Injected subcutaneously 1 c.c. blood from Dog 167, containing active trypanosomes.

September 24. The blood of the rat showed the presence of trypanosomes to-day, five days after injection.

The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 19	−	−	−
„ 20	...	...	−
„ 21	...	...	−
„ 22	...	...	−
„ 23	...	...	−
„ 24	...	...	+
Oct. 4	...	...	+
„ 11	...	...	+

October 11. Animal died at 12 noon. Post-mortem.

The body is not emaciated. No œdematous swellings. The superficial glands are enlarged. No increase of fluid in pericardial, pleura or peritoneal cavities.

Heart.—Petechiæ present on surface. The blood from this organ shows very many active trypanosomes.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Markedly enlarged. On staining a film various modifications in shape of the trypanosomes from the normal are observed, some being swollen and vacuolated, others are quadrilateral or circular; the macro and micro-nuclei stain well.

Kidneys.—Nothing noteworthy.

Lymphatic glands.—The retroperitoneal are considerably enlarged.

On the effect of the injection of these Trypanosomes into Oxen, Sheep, and Goats.

In addition to injection of blood containing each "strain" of trypanosoma into these animals, other experiments were performed to determine whether any difference could be made out between the various "strains" of trypanosoma; advantage was taken of the fact that these animals (oxen, goats and sheep) proved refractory to two "strains" of trypanosoma to subsequently inject them with blood containing another "strain."

In this way a difference was established between the varieties of trypanosomes under observation.

The results are as follows:—

Experiment 162. Black Bullock.

To note the effects of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into an ox.

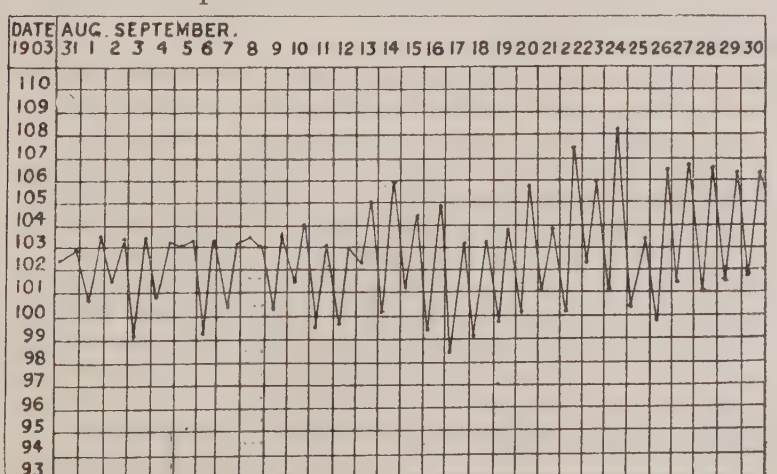
September 9, 1903. Injected 10 c.c. blood subcutaneously from Dog 164 containing trypanosomes of the "Jinja cattle disease."

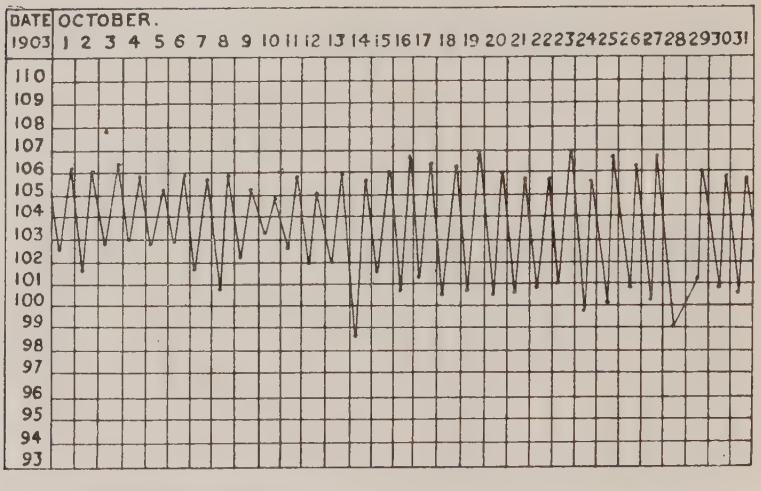
September 21. The animal has been getting thinner lately. Trypanosomes found in the blood to-day twelve days after injection.

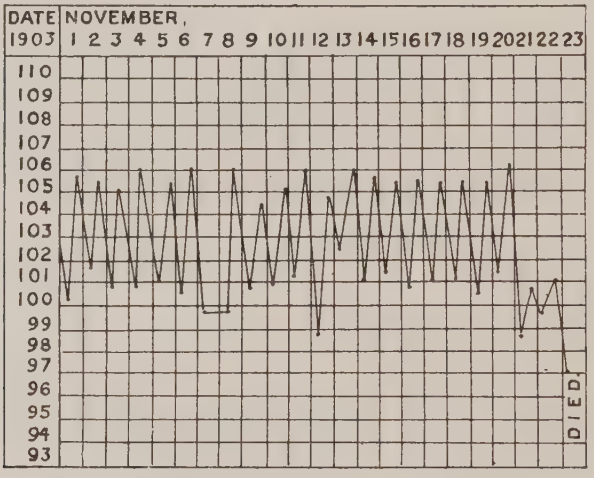
October 8. The animal has been noticed to be lying down a good deal. A slight haziness of the corneæ of both eyes is visible.

November 21. The animal appears very sick to-day, is lying down and cannot be got to rise. Pulse very weak and rapid. This evening appears in moribund condition.

The chart represents the course of the disease:—







The following table shows the presence or absence of trypanosoma in the blood :—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 9	–	–	–
„ 12	...	...	–
„ 15	...	...	–
„ 18	...	...	–
„ 21	...	...	+
„ 23	...	...	+
„ 26	...	...	+
„ 28	...	...	+

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Oct. 2	...	...	+
„ 6	...	...	+
„ 9	...	...	+
„ 12	...	...	+
„ 15	...	...	+
„ 19	...	...	+
„ 21	...	...	+
„ 28	...	...	+
Nov. 4	...	...	+
„ 11	...	...	+
„ 18	...	...	+
„ 21	...	...	+

November 23. Animal died at 12 p.m. Post-mortem at once.

There was slight opacity of the corneæ of both eyes. The supraclavicular lymphatic gland is enlarged and congested, also glands in the neck.

On opening the body some increase of fluid in pericardial cavity is noticed, fluid in pleural and peritoneal cavities not increased.

Heart.—Round the base there is well-marked jelly-like substance. There are petechiæ under epicardium of right auricle, also under endocardium of left ventricle and right auricle. Heart's blood is watery.

Lungs.—Show some jelly-like substance at the division of the main bronchi.

Spleen.—Distinctly enlarged, on section is congested.

Liver and Kidneys.—Nothing noteworthy.

Brain.—Distinct increase of subarachnoid fluid, giving a cloudy appearance to the brain.

Remarks.—This is an important experiment, as it exactly reproduces both clinically and pathologically the features of the disease observed in the cattle originally seen at Jinja. The duration is the same, viz., three months. The mode of death was similar, the animal being apparently not very seriously ill, no emaciation or alteration of coat, and only very slight opacity of corneæ. It lay down about two days before its death and never rose again. It died in fairly good condition as the Jinja cattle died. The post-mortem appearances were also similar to those met with in the Jinja cattle. The appearance of the brain was curious, being not unlike that met with in sleeping sickness cases; portions were preserved for future examination.

Experiment 209. Ox.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into an ox.

October 8, 1903. Injected subcutaneously 5 c.c. of blood from Dog 177 into this ox.

November 27. Injected subcutaneously 20 c.c. ot blood from this ox into Dog 260.

December 2. Again injected subcutaneously 15 c.c. of blood from Dog 256 into this ox.

December 9. Trypanosomes have appeared in the blood of Dog 260 to-day.

January 26, 1904. Again injected subcutaneously 20 c.c. of blood from this ox into Dog 277.

February 23. Trypanosomes appeared in the blood of Dog 277.

September 30. The animal shows some slight emaciation, but no trypanosomes have appeared in its peripheral blood. Injected 20 c.c. of blood subcutaneously into Monkey 319.

The temperature oscillated between 98° and 105°.

Trypanosomes never appeared in the blood of this animal.

Experiment 202. Ox.

To note the effect of subcutaneous injection of blood from an animal suffering from the "mule disease" into an ox.

September 28, 1903. Injected subcutaneously 6 c.c. of blood from monkey, Experiment 180.

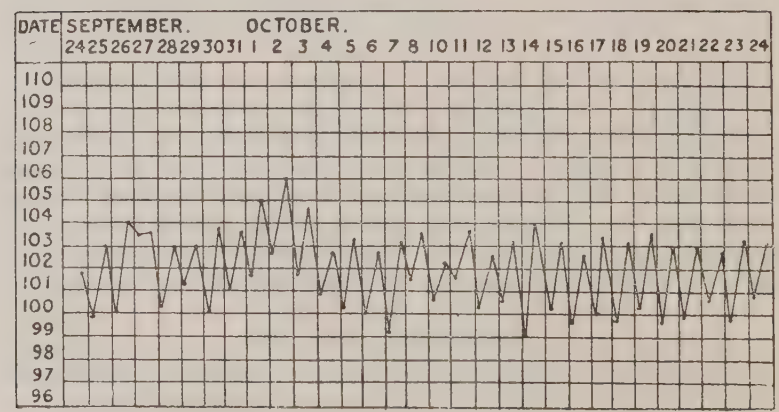
October 15. 10 c.c. blood were centrifuged, no active trypanosomes were found.

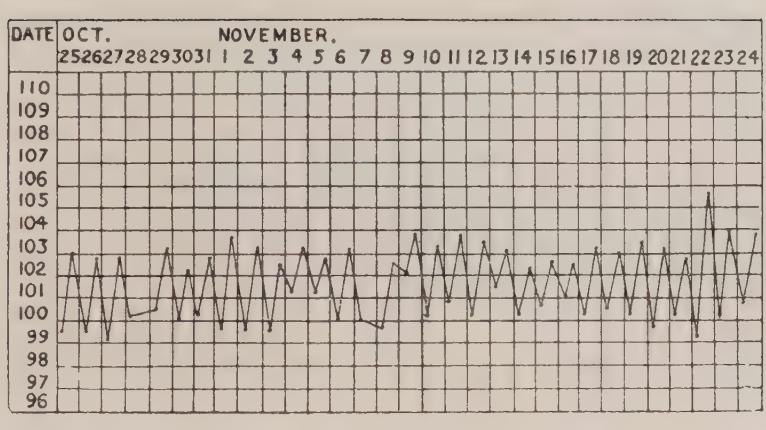
November 2. Injected subcutaneously 20 c.c. of blood from this animal into a dog, Experiment 239.

November 9. Injected subcutaneously 5 c.c. blood from jackal, Experiment 240.

November 10. Trypanosomes appeared to-day in the blood of Dog 239 which was injected with blood from this animal.

The following chart shows the course of the disease:—





This animal was then used for the following observation: —

To note the effect of injection of blood from an animal suffering from another variety of trypanosome disease (Jinja) into an animal previously inoculated with blood from animal affected with the "mule disease," but in whose blood the parasites had not appeared.

November 21. Injected subcutaneously 25 c.c. blood from Ox 162, which was dying.

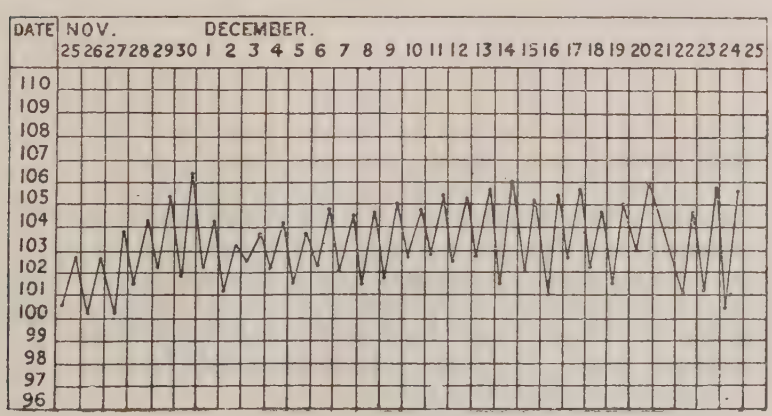
December 2. Trypanosomes appeared in the blood to-day for the first time. This is the 12th day after the injection of the blood. The interval corresponds exactly to the incubation period in the "Jinja disease"; compare Experiment 162.

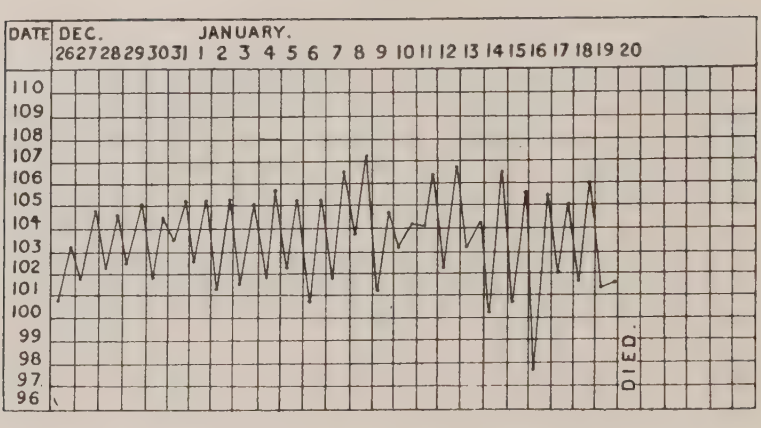
December 15. The animal appears thinner, the coat is not staring.

January 13, 1904. The animal seems less vigorous than before, otherwise there is no noteworthy change.

January 19. The animal is unable to rise to-day. The conjunctivæ are very pale. There is not much emaciation.

The following chart shows the course of the disease:—





The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filaria.	Malaria.	Trypanosoma.
1903.			
Sept. 25	–	–	–
Oct. 2	...	...	–
„ 6	...	...	–
„ 10	...	...	–
„ 13	...	...	–
„ 15	...	...	–
„ 19	...	...	–
„ 21	...	...	–
„ 28	...	...	–
Nov. 4	...	...	–
„ 11	...	...	–
„ 18	...	...	–
„ 21	...	...	–
„ 25	...	...	–
Dec. 2	...	...	+
„ 9	...	...	+
„ 16	...	...	+
„ 23	...	...	+
„ 30	...	...	+
1904.			
Jan. 6	...	...	+
„ 13	...	...	+
„ 19	...	...	+

January 20. The animal died at 12.30 p.m. Post-mortem at once. The body is not emaciated and the coat is not staring. The superficial glands are generally enlarged. There is slight opacity of both corneæ. No jelly-like material seen in subcutaneous tissue. There is no increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—There is some jelly-like material round the base. A

few petechiæ on the surface of the heart, also under endocardium of both ventricles. The muscle substance is pale. The blood from this organ contains active trypanosomes.

Lungs.—In both areas of infarction are seen; they are wedge-shaped and measure about one inch across.

Spleen.—Slightly enlarged and congested.

Kidneys.—Both apparently healthy.

Brain.—Some injection of superficial vessels, sub-arachnoid fluid increased.

Glands.—Along the line of the aorta and iliac vessels are enlarged and on section appeared congested.

Remarks.—This experiment is an important one, and forms one of a series designed to observe whether there was any difference in the effect on cattle between the "Jinja" and the "mule" trypanosomes.

This animal was originally inoculated with the "mule" variety of trypanosome, and for two months, although reinjected, never showed trypanosomes in its peripheral blood. Its blood was, however, infectious, and when injected into a dog, the trypanosomes appeared after the usual interval in its blood. In order to determine whether the Jinja variety of trypanosomes would develop in the blood of this animal, and thus constitute a difference between it and the "mule" variety, it was injected with blood containing the Jinja variety of trypanosomes. After the incubation period of the latter disease, trypanosomes appeared in the blood of this animal and they continued to be present till its death. The symptoms and duration of the disease were exactly the same as in the Jinja disease; compare Experiment 162.

Experiment 193. Sheep.

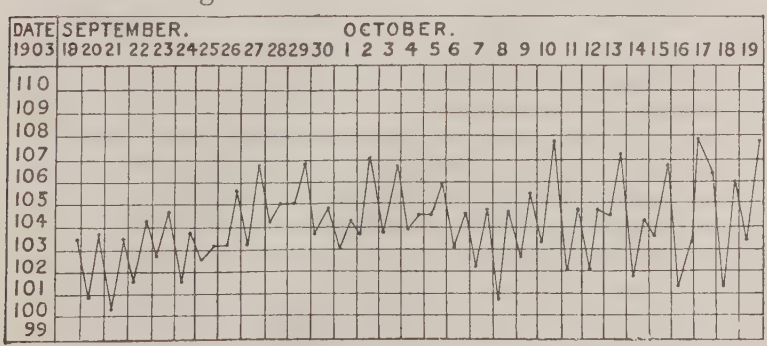
To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a sheep.

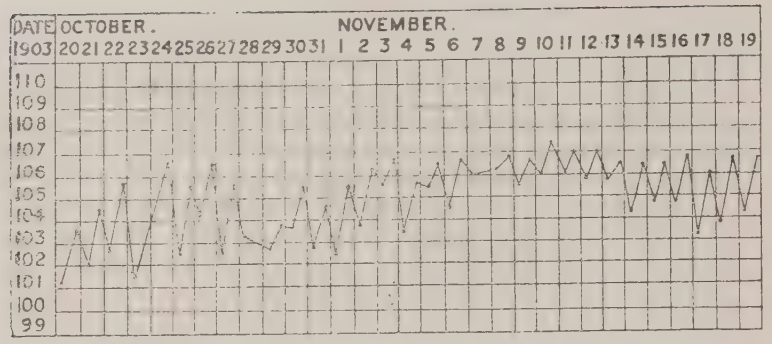
September 25, 1903. Injected subcutaneously 15 c.c. of blood containing active trypanosomes from Monkey 135.

October 13. Many trypanosomes were found in the blood to-day for the first time, eighteen days after inoculation.

February 3, 1904. The animal appears short of breath and is not walking about much. The general state of health is fair.

The following chart shows the course of the disease:—




DATE
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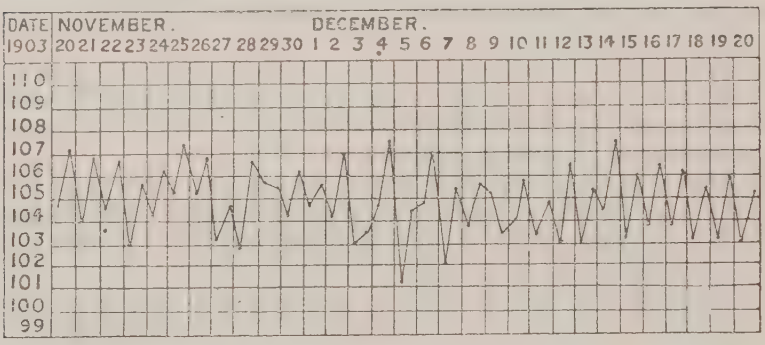
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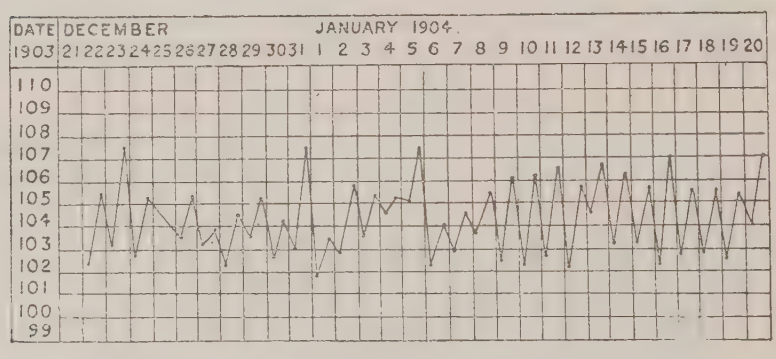
DATE
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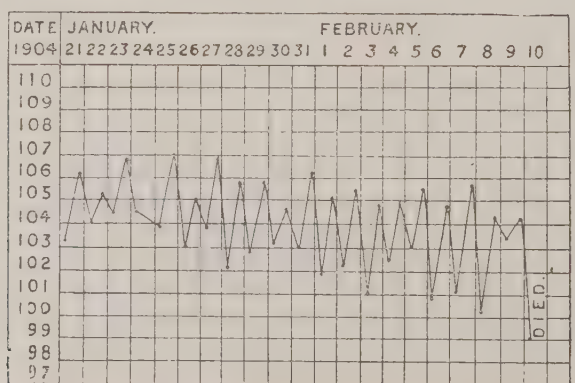
DATE
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DIED.

The following table shows the presence or absence of trypanosomes in the blood :—

Date.			Parasites in the blood.		
			Filaria.	Malaria.	Trypanosoma.
	1903.				
Sept.	23	... ...	–	–	–
„	30	... ...	...	...	–
Oct.	3	... ...	...	...	–
„	7	... ...	...	...	–
„	10	... ...	...	...	–
„	11	... ...	...	...	–
„	13	... ...	...	...	+
„	16	... ...	...	...	–
„	17	... ...	...	...	+
„	19	... ...	...	...	+
„	21	... ...	...	...	–
„	27	... ...	...	...	+
Nov.	4	... ...	...	...	–
„	11	... ...	...	...	–
„	18	... ...	...	...	+
„	25	... ...	...	...	+
Dec.	2	... ...	...	...	+
„	9	... ...	...	...	+
„	16	... ...	...	...	–
„	23	... ...	...	...	+
„	30	... ...	...	...	+
	1904.				
Jan.	6	... ...	...	...	+
„	13	... ...	...	...	+
„	20	... ...	...	...	+
„	27	... ...	...	...	+
Feb.	2	... ...	...	...	+
„	9	... ...	...	...	+

February 10. Animal died about 3 p.m. Post-mortem.

There is no marked emaciation. Conjunctivæ pale—slight haziness of corneæ present. There is some increase of pericardial fluid, no increase of fluid in pleural or peritoneal cavities.

Heart.—Well-marked jelly-like material round base.

No endocardial petechiæ. The muscle is very pale. The blood of this organ contained active trypanosomes.

Lungs.—Both are healthy.

Liver.—Nothing noteworthy.

Spleen.—Not enlarged.

Kidneys.—Both pale.

Glands.—In both iliac regions they are enlarged and congested.

Remarks.—This is an interesting experiment, as it clearly demonstrates the course of this disease in a sheep. The animal was not emaciated. It showed no œdema of the sheath or other part. It was only shortly before its death that the animal

showed any abnormal signs, and these were mainly breathlessness and a tendency to lie about.

Experiment 211. Sheep.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a sheep.

October 8, 1903. Injected 5 c.c. of blood containing active trypanosomes from Dog 177 into this sheep.

December 2. Again injected 10 c.c. of blood from Dog 256.

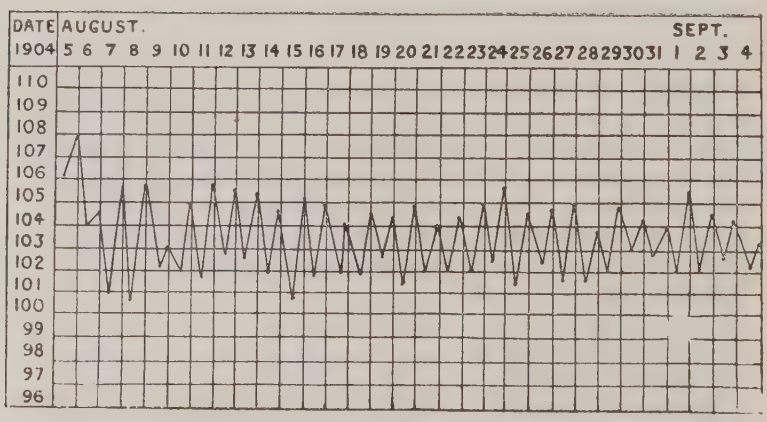
January 13, 1904. This animal keeps in good health and trypanosomes have not appeared in the peripheral blood. The temperature remained normal throughout.

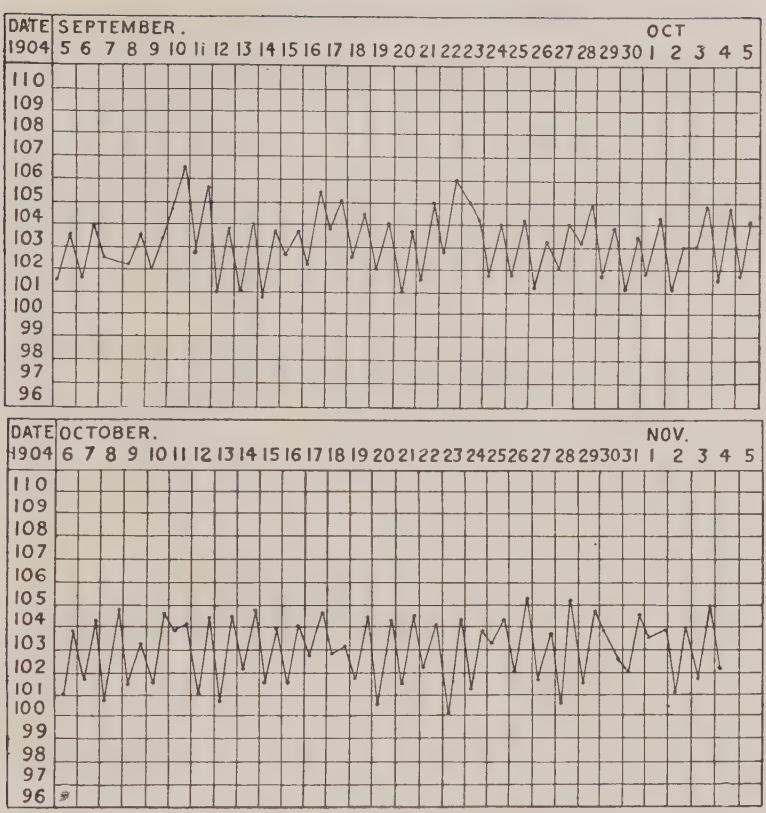
Trypanosomes having failed to appear in the blood, this animal was used "to note effect of subcutaneous injection of blood from an animal suffering from the 'Jinja cattle disease' into a sheep previously inoculated subcutaneously with blood from an animal suffering from 'Abyssinian fly disease,' to which it proved refractory."

August 23, 1904. Eight months after previous injection no trypanosomes having appeared in the blood, 1·5 c.c. of blood from Rabbit 289 was injected subcutaneously into this sheep.

September 28. Trypanosomes appeared in the blood to-day.

The following chart represents the course of the disease:—





The following table shows the presence or absence of trypanosomes in the blood:—

Date.	Parasites in the blood.		
	Filar.	Malar.	Tryp.
1904.			
June 15	...	...	−
„ 22	...	...	−
„ 28	...	...	−
July 13	...	...	−
„ 20	...	...	−
„ 27	...	...	−
Aug. 10	...	...	−
„ 17	...	...	−
„ 30	...	...	−
Sept. 7	...	...	−
„ 14	...	...	−
„ 21	...	...	−
„ 28	...	...	+
Oct. 5	...	...	+
„ 12	...	...	−
„ 19	...	...	+
Nov. 2	...	...	+

Experiment 194. Sheep.

To note the effect of subcutaneous injection of blood from an animal suffering from the "mule disease" into a sheep.

September 28, 1903. Injected 3 c.c. of blood from Monkey No. 180, containing active trypanosomes.

November 8. The trypanosomes not having appeared in the blood of this animal, it was reinjected with 7 c.c. of blood from Jackal No. 240, containing many trypanosomes.

January 6, 1904. The animal is fat and maintains its health well.

February 9th. The general condition of the animal is good. The temperature remained normal throughout.

The blood was examined weekly, but trypanosomes were never found in the peripheral blood.

June 18. Animal died at 12.30 p.m. Post-mortem.

The body is not emaciated. There are no œdematous swellings. No opacity of corneæ.

There is some increase of fluid in the pericardial cavity; no increase of fluid in pleural or peritoneal cavities.

Heart.—A considerable amount of jelly-like material round base. The muscle is pale, otherwise nothing noteworthy. No active trypanosomes in heart's blood.

Lungs.—Nothing noteworthy.

Liver.—Is congested.

Spleen.—Not enlarged.

Glands in neck enlarged and congested. Juice contains no active trypanosomes.

Remarks.—This experiment is of considerable interest, as it shows the course of this disease in the sheep. As compared with the Jinja disease it runs a very chronic course, and, like the same disease in the Goat 194 and Ox 202, trypanosomes never appeared in the peripheral blood, although the blood of the latter was infective to dogs. There can be little doubt that in the sheep also the result of injection of blood containing this variety of trypanosome is to produce a chronic disease which ultimately kills the animal.

Experiment 192. Goat.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Jinja cattle disease" into a goat.

September 25, 1903. Injected subcutaneously 15 c.c. of blood from Monkey 135, containing many trypanosomes, into this goat.

October 8. There was some local reaction at the site of inoculation, but no abscess formation.

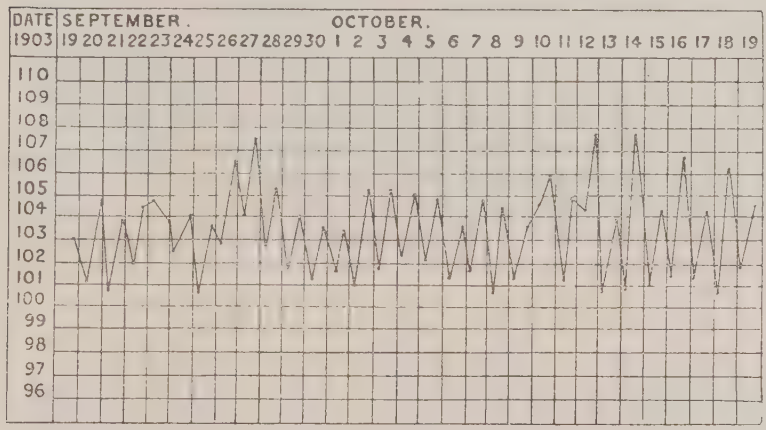
October 10. Trypanosomes appeared in the blood to-day in considerable numbers, the fifteenth day after inoculation.

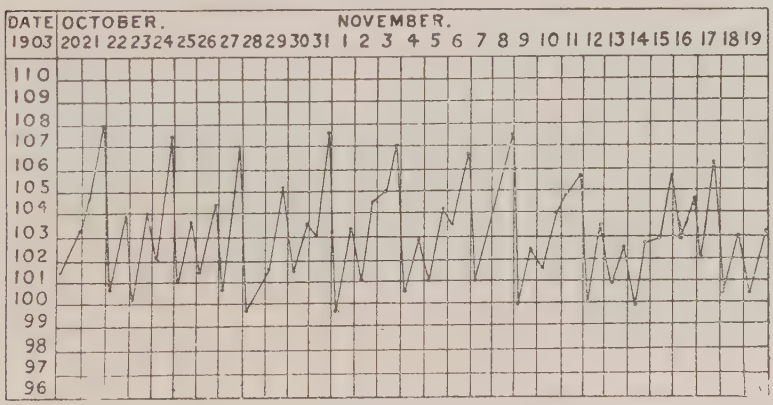
April 27, 1904. An enlarged lymphatic gland was felt in

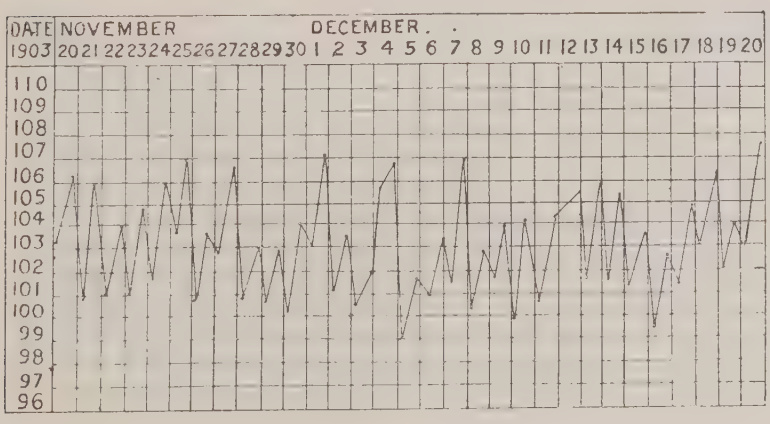
the right supra-clavicular region. This was punctured; the juice showed many active trypanosomes.

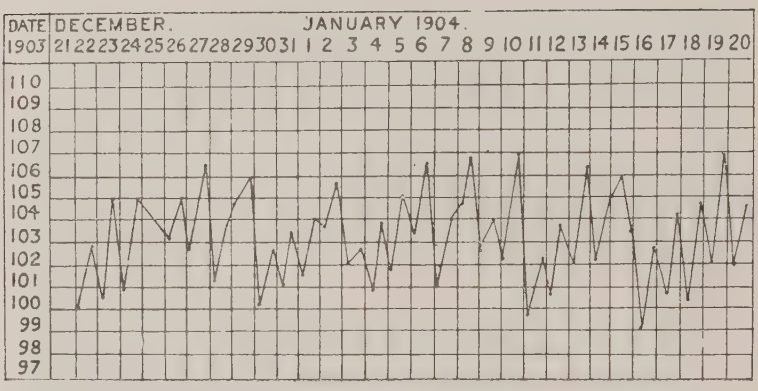
September 27. The animal keeps in good condition. The trypanosomes remain present in the blood.

The following chart shows the course of the disease:—





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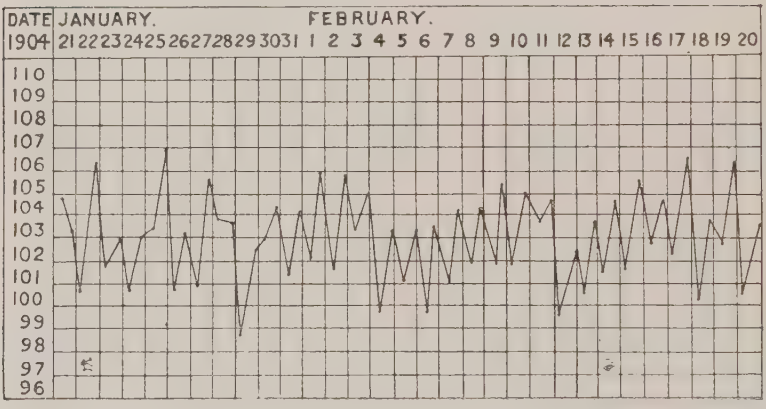
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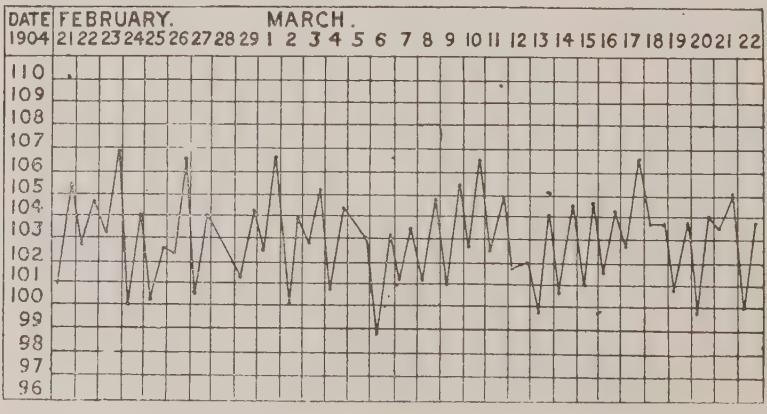
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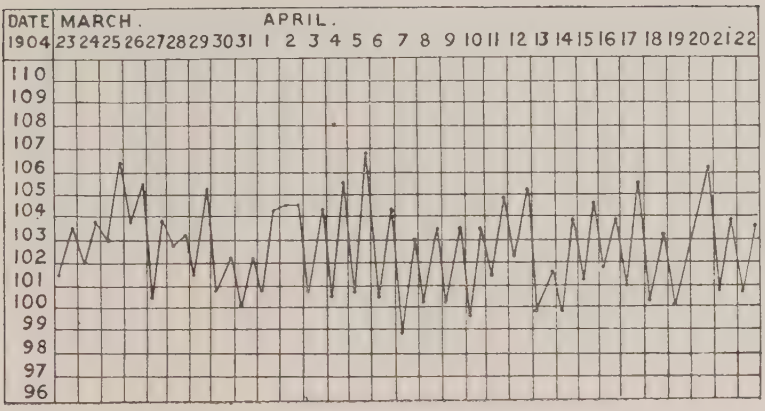
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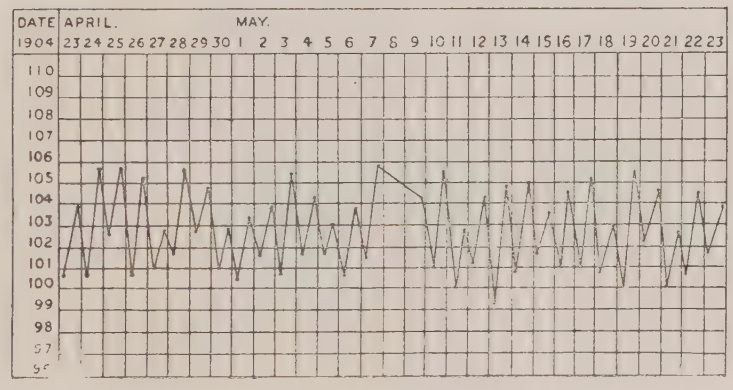
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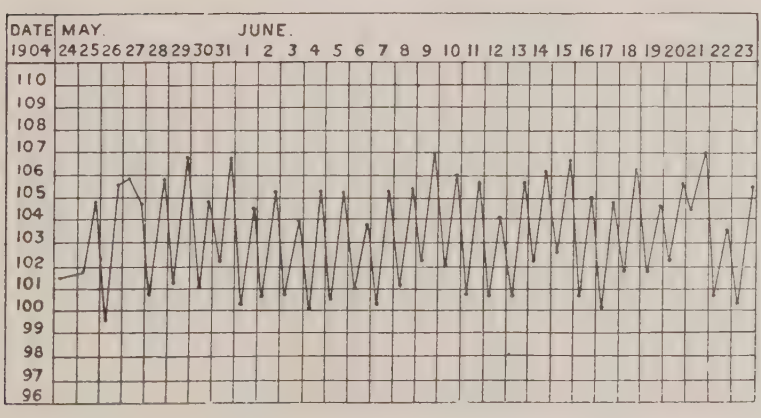
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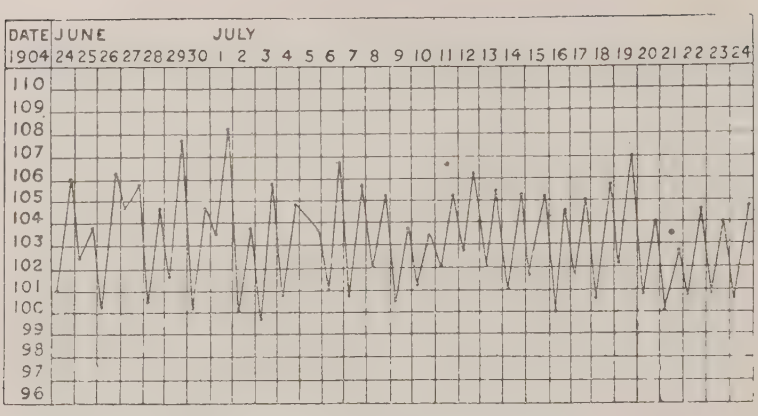
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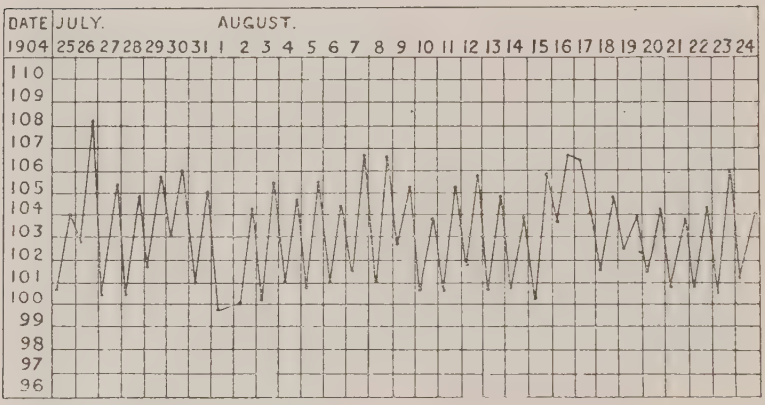
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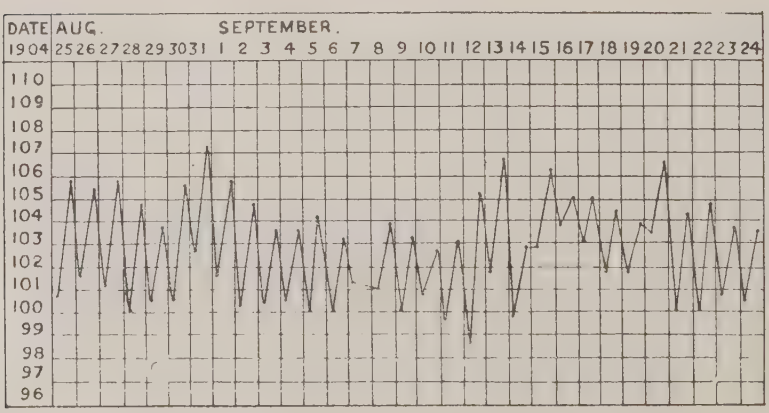
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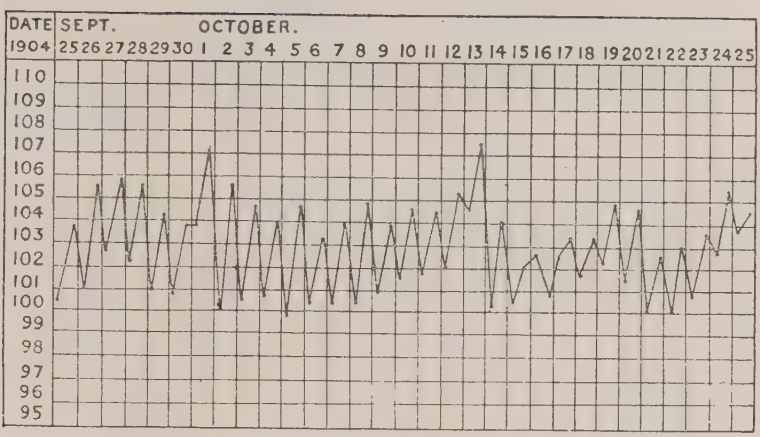
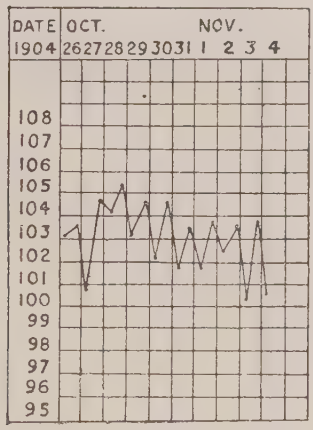




The following table shows the presence or absence of trypanosomes in the blood :—

Date.				Parasites in the blood.		
				Filaria.	Malaria.	Trypanosoma.
	1903.					
Sept.	23	...	...	...	...	−
„	30	...	...	...	...	−
Oct.	3	...	...	...	...	−
„	7	...	...	...	...	−
„	10	...	...	...	...	+
„	13	...	...	...	...	+
„	16	...	...	...	...	+
„	19	...	...	...	...	+
„	21	...	...	...	...	+
„	28	...	...	...	...	−

Date.				Parasites in the blood.		
				Filaria.	Malaria.	Trypanosoma.
	1903.					
Nov.	4	...	...	...	...	−
,,	11	...	...	...	...	+
,,	18	...	...	...	...	+
,,	25	...	...	...	...	+
Dec.	2	...	...	...	...	−
,,	9	...	...	...	...	−
,,	16	...	...	...	...	−
,,	23	...	...	...	...	−
,,	30	...	...	...	...	−
	1904.					
Jan.	6	...	...	...	...	+
,,	13	...	...	...	...	+
,,	20	...	...	...	...	+
,,	27	...	...	...	...	+
Feb.	3	...	...	...	...	+
,,	9	...	...	...	...	+
,,	17	...	...	...	...	+
,,	24	...	...	...	...	−
March	2	...	...	...	...	+
,,	9	...	...	...	...	+
,,	16	...	...	...	...	+
,,	23	...	...	...	...	+
,,	30	...	...	...	...	+
April	7	...	...	...	...	−
,,	20	...	...	...	...	−
,,	27	...	...	...	...	+
May	4	...	...	...	...	−
,,	11	...	...	...	...	−
,,	18	...	...	...	...	+
,,	24	...	...	...	...	+
June	1	...	...	...	...	−
,,	7	...	...	...	...	−
,,	14	...	...	...	...	+
,,	22	...	...	...	...	−
,,	29	...	...	...	...	+
July	13	...	...	...	...	+
,,	26	...	...	...	...	−
Aug.	10	...	...	...	...	−
,,	17	...	...	...	...	−
,,	30	...	...	...	...	+
Sept.	7	...	...	...	...	−
,,	14	...	...	...	...	−
,,	28	...	...	...	...	−
Oct.	13	...	...	...	...	+
,,	19	...	...	...	...	+
Nov.	2	...	...	...	...	+

Remarks.—This experiment illustrates the very chronic course of this disease in goats. The condition of the animal is good.

Experiment 212. Goat.

To note the effect of subcutaneous injection of blood from an animal suffering from the "Abyssinian fly disease" into a goat.

October 8, 1903. Injected subcutaneously 5 c.c. of blood containing active trypanosomes from Dog 177 into this goat.

December 2. Again injected 10 c.c. of blood from Dog 256.

January 13, 1904. The general condition of this animal is good. Trypanosomes have not appeared in the blood.

The temperature remained normal throughout.

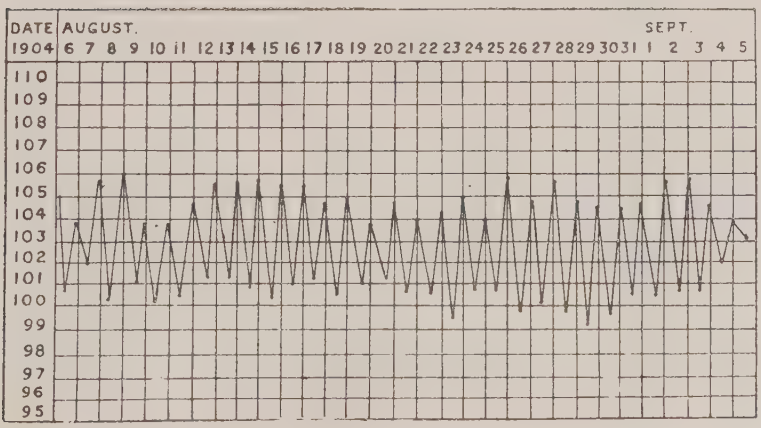
The blood was examined weekly, but no trypanosomes were found in the peripheral circulation at any time.

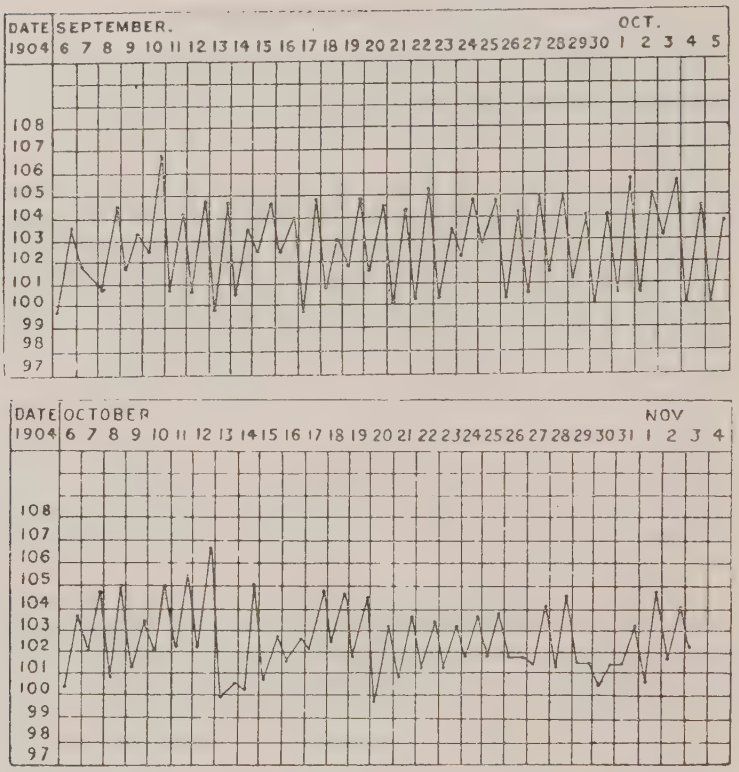
Trypanosomes having failed to appear in the blood, this animal was used "to note the effect of subcutaneous injection of blood from an animal suffering from the 'Jinja cattle disease' into a sheep previously inoculated subcutaneously with blood from an animal suffering from 'Abyssinian fly disease,' to which it proved refractory."

August 23. Eight months after previous injection, no trypanosomes having appeared in the blood, 1·5 c.c. of blood, containing many trypanosomes, from Rabbit 289, was injected subcutaneously.

September 28. Trypanosomes have appeared in the blood to-day.

The following chart represents the course of the disease:—





The following table shows the presence or absence of trypanosomes in the blood :—

Date.				Parasites in the blood.		
				Filaria.	Malaria.	Trypanosoma.
	1904.					
June	8	...	...	...	...	−
,,	15	...	...	...	...	−
,,	22	...	...	...	...	−
,,	29	...	...	...	...	−
July	12	...	...	...	...	−
,,	20	...	...	...	...	−
,,	27	...	...	...	...	−
August	10	...	...	...	...	−
,,	17	...	...	...	...	−
,,	30	...	...	...	...	−
Sept.	7	...	...	...	...	−
,,	14	...	...	...	...	−
,,	28	...	...	...	...	+
Oct.	5	...	...	...	...	+
,,	12	...	...	...	...	−
,,	19	...	...	...	...	+
Nov.	2	...	...	...	...	+

Experiment 194. Goat.

To note the effects of subcutaneous injection of blood from an animal suffering from "mule cattle disease" into a goat.

September 28, 1903. Injected 3 c.c. of blood containing trypanosomes from a monkey, Experiment 180.

November 8. The trypanosomes have not appeared in the blood of this animal. Reinjected with 7 c.c. of blood from jackal, Experiment 240.

The temperature remained normal throughout.

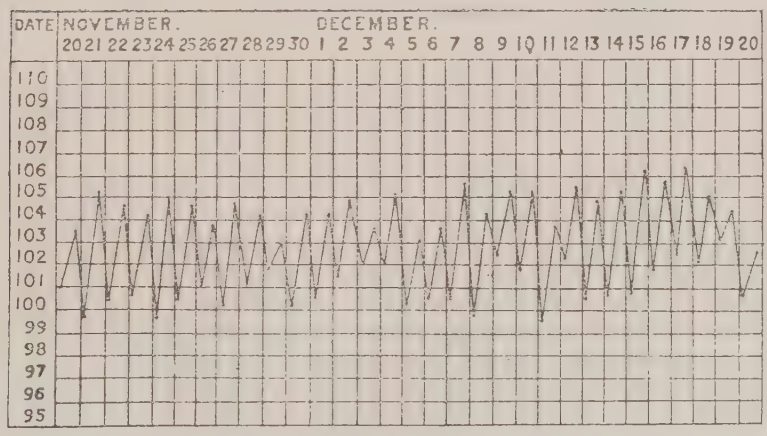
The trypanosomes not having appeared in the blood of this animal, it was used "to note the effect of injection of blood from an animal suffering from the 'Jinja cattle disease' into a goat previously injected with blood containing the 'mule' variety of trypanosome, but which had not appeared in the peripheral blood."

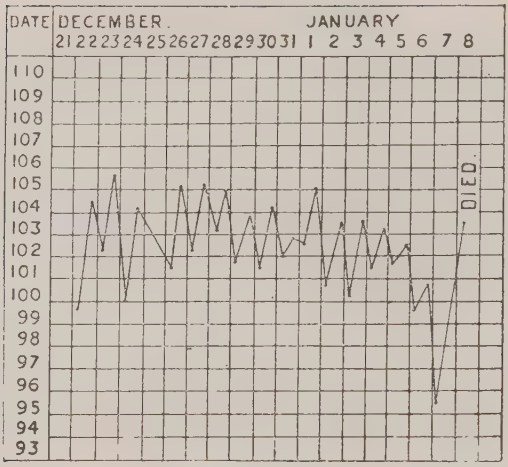
November 21. Injected 10 c.c. of blood subcutaneously from ox, Experiment 162, which was dying.

December 2. The trypanosomes appeared in the blood to-day for the first time, eleven days after inoculation.

January 6, 1904. The animal is pregnant. She appears sick and is lying down.

The following chart shows the course of the disease :—





The following table shows the presence or absence of trypanosomes in the blood:—

Date.				Parasites in the blood.		
				Filaria.	Malaria.	Trypanosoma.
	1903.					
Sept.	22	...	...	–	–	–
„	30	...	...	...	...	–
Oct.	3	...	...	...	...	–
„	6	...	...	...	...	–
„	10	...	...	...	...	–
„	13	...	...	...	...	–
„	16	...	...	...	...	–
„	19	...	...	...	...	–
„	21	...	...	...	...	–
„	26	...	...	...	...	–
„	28	...	...	...	...	–
Nov.	2	...	...	...	...	–
„	4	...	...	...	...	–
„	11	...	...	...	...	–
„	18	...	...	...	...	–
„	25	...	...	...	...	–
Dec.	2	...	...	...	...	+
„	9	...	...	...	...	+
„	16	...	...	...	...	+
„	23	...	...	...	...	+
„	30	...	...	...	...	+
	1904.					
Jan.	6	...	...	...	...	+
„	8	...	...	...	...	+

January 6. Animal died this morning. Post-mortem.

No emaciation. There is no opacity of the corneæ or œdematous swellings. The superficial glands are slightly

enlarged. No increase of fluid in the pleural, pericardial or peritoneal cavities.

Heart.—A considerable amount of jelly-like material round the base. There are a few petechiæ over right auricle. There are no petechiæ under endocardium. The muscle is pale. The blood of this organ contains trypanosomes.

Lungs.—Both show small extravasations under pleural membrane, otherwise nothing noteworthy.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged; substance is soft and friable. Smears from this organ show the presence of trypanosomes.

Kidneys.—Jelly-like substance surrounds both.

Glands.—Along the great vessels they are distinctly enlarged.

Uterus.—Contains two practically full time fœtuses. The heart blood of the fœtus shows no trypanosomes, nucleated red corpuscles were abundant.

Remarks.—This experiment is an interesting and important one. Its object was to determine firstly the effect of injection of blood containing the "mule variety of trypanosome," and secondly, when this latter failed to appear in the blood, to determine whether the "Jinja cattle" trypanosome would develop in the blood of the same animal. The first injection was not followed by the appearance of trypanosomes in the blood, although two inoculations were performed, but when the blood containing the "Jinja variety" of trypanosome was injected the parasites appeared in the blood after the usual incubation period for this disease and continued to be present until the death. The death was due to the trypanosomes, perhaps hastened by the pregnancy. The above experiment suggests that as regards their action in goats there is a difference between the trypanosomes of the "mule" and the "Jinja cattle."

16. *Are we dealing with one or more than one species of Trypanosoma?*

As has been shown the Trypanosoma gambiense differs in morphological characters from the animal varieties studied here. The difference is more marked in their behaviour when inoculated into the various experimental animals. From a consideration of the results obtained, the first conclusion that will be arrived at is that the trypanosomes found in the animals in Uganda are different from those found in sleeping sickness cases, and in men showing no signs of sleeping sickness, the two latter trypanosomes being identical, being in fact the Trypanosoma gambiense of the West Coast. As to the nature of the animal trypanosomes, the facts may be summed up as follows:—The trypanosoma of Mr. Pordage's ox when inoculated into a monkey and dog failed to appear in the blood of either; it further appeared and developed in the blood of an ox. In these results a difference is established

between this variety of trypanosoma and the Trypanosoma gambiense. Owing to the fact that it did not take in the experimental animals, it was not possible to study this "strain" so fully as the others.

With regard to the other varieties it will be at once obvious that the Jinja trypanosoma marks itself off from the other two in its behaviour when inoculated into animals. It runs a more acute course, and is capable of developing in all the experimental animals except the baboon, whilst the Abyssinian and mule do not develop in the blood of sheep, oxen and goats. Thus a distinct difference is constituted between the Jinja trypanosoma on the one hand and the Abyssinian and the mule on the other. This was also established by inoculating animals resistant to the two latter varieties of trypanosoma with the Jinja "strain."

The reactions in animals of the trypanosoma found in the mule at Entebbe and that obtained from the Abyssinian boundary are in all respects similar. The Jinja trypanosoma most closely approaches the classical African type (Nagana), and is, probably, identical with it. The other two differ from this type, and may be provisionally included under the unclassed varieties of African trypanosomes. It may be briefly stated that the species of trypanosomes which have been met with here are: (1) Trypanosoma gambiense, which is identical with those found in sleeping sickness cases and in cases of so-called "Trypanosoma fever"; (2) *Trypanosoma brucei* or a very closely related species, with which the Jinja cattle trypanosoma is identical; (3) a trypanosoma which occasioned the death of mules in Abyssinia and a mule in Uganda, and which is provisionally unclassed; (4) the trypanosoma of Mr. Pordage's ox.

The following table shows the result of the injection of the various animals with the different "strains" of trypanosomes:—

Table showing the results of injection of the various trypanosomes found in Uganda into different animals.

Animals used for experiment.	Presence or absence of trypanosomes in the blood after inoculation with fluids containing trypanosomes from						
	Sleeping sickness cases.	Men having no marked signs of sleeping sickness.	Fresh flies, Entebbe.	Mr. Pordage's ox.	Jinja cattle.	Abyssinian animals.	Mule, Entebbe.
1. Monkeys—							
a. Cercopithecus sp. ...	+	+	+	–	+	+	+
b. Macacus Rhesus ...	+	+	...	...	...	...	...
2. Dogs—							
a. Adult	+	+	+	-	+	+	+
b. Pup	–	–	...	...	...	...	...
3. Jackals	+	+	...	...	...	...	+
4. Cats—							
a. Adult	+	+	...	...	...	...	...
b. Kitten	+	+	...	...	...	...	...
5. Rats	+	+	...	...	+	+	+
6. Rabbtis	...	...	...	...	+	...	+
7. Guinea pigs...	+	+	...	...	+	+	+
8. Sheep	–	–	...	...	+	–	–
9. Goats	–	–	...	...	+	–	-
10. Oxen	–	–	...	...	+	–	–
11. Masai donkey	–	–	...	...	+	+	+
12. Dog-faced baboons ...	...	...	...	...	–	–	–
13. Mule	...	...	...	...	...	...	+

TABLE SHOWING RESULT OF INOCULATION OF ANIMALS IMMUNE TO ONE VARIETY OF TRYPANOSOMA, WITH ANOTHER STRAIN :—

No. of Experiment.	Variety of Trypanosoma to which animal is immune.	Variety of Trypanosoma used for inoculation.	Date of Inoculation.	Result of Inoculation.	Remarks.
Ox 202	Mule	Jinja	Nov. 21, 1903 ...	Trypanosomes appeared in the blood on the 12th day. Died 20.1.04.	Rise of temperature after inoculation.
Goat 194... ...	"	"	" " ...	Trypanosomes appeared in the blood on the 12th day. Died 20.1.04.	... ...
Sheep 191 ...	"	"	Control	... ...	Trypanosomes have never appeared in the blood.
Sheep 211 ...	Abyssinian	"	Aug. 23, 1904 ...	Trypanosomes appeared in the blood 36 days after inoculation.	Still alive.
Goat 212 ...	"	"	" " ...	Trypanosomes appeared in the blood 36 days after inoculation.	Still alive.
Ox 209	"	"	Control	... ...	Trypanosomes have never appeared in the blood.

17. *Can the* Glossina palpalis *convey the Trypanosoma found in the Jinja Cattle, Entebbe and Abyssinian Mules to Healthy Animals?*

The animal employed for these experiments was the monkey. The dog is quite unsuitable owing to the difficulty, already mentioned, of obtaining an animal free from anchylostomes. The method employed was to feed tsetse flies on an animal suffering from the above diseases and then, after varying intervals of time, to place the same cage of flies on a healthy monkey. Only the flies which had filled themselves were counted as having fed:—

EXPERIMENT 196. MONKEY (*Cercopithecus sp.*).

Feeding tsetse flies (*Glossina palpalis*) on a healthy monkey 6 hours after they had been fed on a monkey infected with the "Jinja cattle disease."

Date.	Number of flies fed on:—		Tryp.	Date.	Number of flies fed on:—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Sept. 22...	...	...	Absent.	Oct. 8...	11	8	...
„ 23...	10	11	...	„ 9...	9	13	...
„ 24...	7	13	...	„ 10...	11	14	Absent.
„ 25...	16	14	Absent.	„ 11...	14	16	...
„ 26...	15	14	...	„ 12...	7	12	...
„ 27...	10	17	...	„ 13...	6	12	...
„ 28...	20	12	...	„ 14...	12	10	...
„ 29...	14	9	...	„ 15...	10	8	...
„ 30...	12	10	...	„ 16...	12	14	...
Oct. 1...	16	12	...	„ 17...	10	9	*Present.*
„ 2...	12	11	...	„ 18...	...	...	...
„ 3...	13	8	Absent.	„ 19...	...	...	...
„ 4...	14	9	...	„ 20...	...	...	...
„ 5...	10	9	...	„ 21...	...	...	...
„ 6...	18	11	...	„ 22...	...	...	...
„ 7...	9	10	...	...	...	...	...

EXPERIMENT 204. MONKEY (*Cercopithecus sp.*).

Feeding flies (*Glossina palpalis*) on a healthy monkey 24 hours after they had been fed on a monkey infected with the trypanosomes of the "Jinja cattle disease."

Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.	
1903.			
Sept. 27...	...	14	Absent.
„ 28...	17	...	...
„ 29...	...	24	...
„ 30...	26	...	...
Oct. 1...	...	12	...
„ 2...	14	...	...
„ 3...	...	...	...
„ 4...	5	...	...
„ 5...	...	16	Absent.
„ 6...	14	...	...
„ 7...	...	9	...
„ 8...	9	...	...
„ 9...	...	16	...
„ 10...	12	...	Absent.
„ 11...	...	12	...
„ 12...	14	...	...
„ 13...	...	9	...
„ 14...	40	...	...
„ 15...	...	14	...
„ 16...	24	...	...
„ 17...	...	26	Absent.
„ 18...	12	...	...
„ 19...	...	16	...
„ 20...	9	...	...
„ 21...	...	20	...
„ 22...	8	...	Absent.
„ 23...	...	18	...
„ 24...	10	...	...
„ 25...	...	16	...
„ 26...	12	...	...
„ 27...	...	8	...
„ 28...	11	...	...
„ 29...	...	0	Absent.
„ 30...	14	...	...
„ 31...	...	14	...
Nov. 1...	16	...	...
„ 2...	...	5	...
„ 3...	10	...	...
„ 4...	...	14	Absent.
„ 5...	8	...	...
„ 6...	...	12	...
„ 7...	5	...	...
„ 8...	...	0	...
„ 9...	4	...	...
„ 10...	...	0	...
„ 11...	20	...	...
„ 12...	...	10	Absent.
„ 13...	8	...	...
„ 14...	...	12	...
„ 15...	14	...	...
„ 16...	..	6	...
„ 17...	7	...	...
„ 18...	...	8	...

Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.	
1903.			
Nov. 19...	4	...	Absent.
„ 20...	...	6	...
„ 21...	8	...	...
„ 22...	...	0	...
„ 23...	13	...	...
„ 24...	...	0	...
„ 25...	4	...	...
„ 26...	...	8	Absent.
„ 27...	7	...	...
„ 28...	...	10	...
„ 29...	6	...	...
„ 30...	...	8	...
Dec. 1...	10	...	...
„ 2...	...	12	...
„ 3...	10	...	Absent.
„ 4...	...	6	...
„ 5...	8	...	...
„ 6...	...	4	...
„ 7...	6	...	...
„ 8...	...	3	...
„ 9...	6	...	...
„ 10...	...	5	Absent.
„ 11...	8	...	...
„ 12...	...	0	...
„ 13...	3	...	...
„ 14...	...	6	...
„ 15...	6	...	...
„ 16...	...	7	...
„ 17...	3	...	Absent.
„ 18...	...	4	...
„ 19...	4	...	...
„ 20...	...	3	...
„ 21...	5	...	...
„ 22...	...	2	...
„ 23...	5	...	...
„ 24...	...	3	Absent.
„ 25...	0	...	...
„ 26...	...	7	...
„ 27...	12	...	...
„ 28...	...	2	...
„ 29...	15	...	...
„ 30...	...	19	...
„ 31...	12	...	Absent.
1904.			
Jan. 1...	...	12	...
„ 2...	10	...	...
„ 3...	...	0	...
„ 4...	10	...	...
„ 5...	...	6	...
„ 6...	13	...	...
„ 7...	...	5	Absent.
„ 8...	15	...	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1904.				1904.			
Jan. 9...	...	10	...	Jan. 19...	...	12	...
„ 10...	9	...	...	„ 20...	8	...	...
„ 11...	...	7	...	„ 21...	...	4	Absent.
„ 12...	12	...	...	„ 22...	14	...	...
„ 13...	...	0	...	„ 23...	...	8	...
„ 14...	7	...	Absent.	„ 24...	6	...	...
„ 15...	...	12	...	„ 25...	...	7	...
„ 16...	6	...	...	„ 26...	10	...	...
„ 17...	...	9	...	„ 27...	...	3	...
„ 18...	5	...	...	„ 28...	4	...	*Present.*

Experiment 199. Monkey (*Cercopithecus sp.*).

Feeding tsetse flies (*Glossina palpalis*) on a healthy monkey 6 hours after they had been fed on a monkey infected with the trypanosome of the "Abyssinian fly disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Sept. 26	14	10	Absent.	Oct. 18	9	7	...
„ 27	11	14	...	„ 19	8	12	...
„ 28	8	3	...	„ 20	12	9	...
„ 29	20	13	...	„ 21	10	11	...
„ 30	27	11	...	„ 22	12	14	...
Oct. 1	8	9	...	„ 23	11	17	Absent.
„ 2	8	6	...	„ 24	10	9	...
„ 3	6	9	Absent.	„ 25	8	26	...
„ 4	11	7	...	„ 26	12	10	...
„ 5	14	8	...	„ 27	10	13	...
„ 6	20	12	...	„ 28	18	14	...
„ 7	11	17	...	„ 29	20	12	Absent.
„ 8	9	14	...	„ 30	18	14	...
„ 9	6	20	...	„ 31	20	12	...
„ 10	10	13	Absent.	Nov. 1	18	12	...
„ 11	11	9	...	„ 2	12	14	...
„ 12	14	10	...	„ 3	14	12	...
„ 13	16	11	...	„ 4	12	10	...
„ 14	14	18	...	„ 5	14	16	Absent.
„ 15	21	8	...	„ 6	16	10	...
„ 16	14	18	...	„ 7	14	0	...
„ 17	12	14	Absent.	„ 8	16	18	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1904.			
Nov. 9	14	12	...	Jan. 1	6	6	...
„ 10	12	14	...	„ 2	4	11	...
„ 11	10	16	...	„ 3	19	6	...
„ 12	12	14	Absent.	„ 4	22	10	...
„ 13	10	8	...	„ 5	10	6	...
„ 14	8	12	...	„ 6	5	12	...
„ 15	7	10	...	„ 7	5	6	Absent.
„ 16	12	10	...	„ 8	12	5	...
„ 17	9	9	...	„ 9	8	12	...
„ 18	10	10	...	„ 10	12	10	...
„ 19	12	16	Absent.	„ 11	10	7	...
„ 20	14	15	...	„ 12	6	5	...
„ 21	9	8	...	„ 13	10	7	...
„ 22	7	8	...	„ 14	5	7	Absent.
„ 23	6	14	...	„ 15	10	6	...
„ 24	12	11	...	„ 16	14	10	...
„ 25	14	4	...	„ 17	6	7	...
„ 26	12	14	Absent.	„ 18	8	7	...
„ 27	14	8	...	„ 19	5	7	...
„ 28	14	10	...	„ 20	6	5	...
„ 29	16	14	...	„ 21	4	6	Absent.
„ 30	12	3	...	„ 22	8	6	...
Dec. 1	10	12	...	„ 23	8	6	...
„ 2	12	10	...	„ 24	2	8	...
„ 3	10	6	Absent.	„ 25	3	6	...
„ 4	8	10	...	„ 26	2	8	...
„ 5	10	7	...	„ 27	4	4	...
„ 6	8	6	...	„ 28	3	4	Absent.
„ 7	12	6	...	„ 29	2	6	...
„ 8	10	6	...	„ 30	4	5	...
„ 9	8	6	...	„ 31	2	5	...
„ 10	10	8	Absent.	Feb. 1	0	3	...
„ 11	9	11	...	„ 2	3	8	...
„ 12	8	8	...	„ 3	2	3	...
„ 13	5	7	...	„ 4	5	7	Absent.
„ 14	8	8	...	„ 5	6	16	...
„ 15	6	8	...	„ 6	3	10	...
„ 16	8	8	...	„ 7	14	12	...
„ 17	6	4	Absent.	„ 8	10	5	...
„ 18	5	6	...	„ 9	10	8	...
„ 19	10	5	...	„ 10	10	8	...
„ 20	4	5	...	„ 11	18	18	Absent.
„ 21	3	7	...	„ 12	4	6	...
„ 22	4	6	...	„ 13	5	9	...
„ 23	3	6	...	„ 14	5	7	...
„ 24	6	5	Absent.	„ 15	18	14	...
„ 25	0	0	...	„ 16	6	8	...
„ 26	6	3	...	„ 17	5	9	...
„ 27	8	5	...	„ 18	4	7	Absent.
„ 28	9	3	...	„ 19	4	4	...
„ 29	4	2	...	„ 20	4	4	...
„ 30	5	3	...	„ 21	6	2	...
„ 31	10	5	Absent.	„ 22	4	6	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1904.				1904.			
Feb. 23	6	4	...	March 3	4	6	...
„ 24	8	10	...	„ 4	4	6	Absent.
„ 25	4	5	Absent.	„ 5	6	6	...
„ 26	6	8	...	„ 6	6	4	...
„ 27	5	4	...	„ 7	5	3	...
„ 28	5	4	...	„ 8	3	8	...
„ 29	3	4	...	„ 9	4	4	...
March 1	6	8	...	„ 10	4	4	...
„ 2	2	8	...	„ 11	4	5	*Present.*

Experiment 252. Monkey (*Cercopithecus sp.*).

Feeding flies (*Glossina palpalis*) on a healthy monkey 24 hours after they had been fed on a monkey infected with the "Abyssinian fly disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Nov. 14...	...	...	...	Dec. 7...	...	7	...
„ 15...	...	12	...	„ 8...	11	...	...
„ 16...	10	...	...	„ 9...	...	0	...
„ 17...	...	8	...	„ 10...	0	...	Absent.
„ 18...	10	...	...	„ 11...	...	12	...
„ 19...	...	5	Absent.	„ 12...	12	...	...
„ 20...	0	...	...	„ 13...	...	5	...
„ 21...	...	12	...	„ 14...	8	...	...
„ 22...	4	...	...	„ 15...	...	8	...
„ 23...	...	18	...	„ 16...	6	...	...
„ 24...	14	...	...	„ 17...	...	5	Absent.
„ 25...	...	9	Absent.	„ 18...	0	...	...
„ 26...	8	...	...	„ 19...	...	5	...
„ 27...	...	14	...	„ 20...	5	...	...
„ 28...	14	...	...	„ 21...	...	5	...
„ 29...	...	24	...	„ 22...	5	...	...
„ 30...	16	...	...	„ 23...	...	6	...
Dec. 1...	...	7	...	„ 24...	6	...	...
„ 2...	10	...	...	„ 25...	...	0	...
„ 3...	...	12	Absent.	„ 26...	10	...	...
„ 4...	7	...	...	„ 27...	...	8	...
„ 5...	...	9	...	„ 28...	6	...	...
„ 6...	5	...	...	„ 29...	...	5	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1904.			
Dec. 30...	8	...	...	Jan. 18...	...	4	...
„ 31...	...	6	Absent.	„ 19...	7	...	...
1904.				„ 20...	...	4	...
Jan. 1...	4	...	...	„ 21...	5	...	Absent.
„ 2...	...	5	...	„ 22...	...	8	...
„ 3...	6	...	...	„ 23...	24	...	...
„ 4...	...	5	...	„ 24...	...	16	...
„ 5...	3	...	...	„ 25...	0	...	...
„ 6...	...	3	...	„ 26...	...	10	...
„ 7...	10	...	Absent.	„ 27...	0	...	...
„ 8...	...	4	...	„ 28...	...	14	...
„ 9...	8	...	...	„ 29...	2	...	Absent.
„ 10...	...	15	...	„ 30...	...	12	...
„ 11...	4	...	...	„ 31...	2	...	...
„ 12...	...	4	...	Feb. 1...	...	4	...
„ 13...	12	...	...	„ 2...	4	...	...
„ 14...	...	8	...	„ 3...	...	6	...
„ 15...	4	...	...	„ 4...	...	...	*Present.*
„ 16...	...	5	...	„ 5...	...	...	...
„ 17...	5	...	...	„ 6...	...	...	...

EXPERIMENT 203. MONKEY (*Cercopithecus sp.*).

Feeding flies (*Glossina palpalis*) on a healthy monkey 24 hours after they had been fed on a monkey infected with the trypanosomes of the "mule disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Sept. 27...	10	...	Absent.	Oct. 14...	...	11	...
„ 28...	...	10	...	„ 15...	5	...	...
„ 29...	14	...	...	„ 16...	...	8	...
„ 30...	...	9	...	„ 17...	5	...	Absent.
Oct. 1...	10	...	...	„ 18...	...	4	...
„ 2...	...	9	...	„ 19...	9	...	...
„ 3...	11	...	Absent.	„ 20...	...	8	...
„ 4...	...	14	...	„ 21...	10	...	...
„ 5...	11	...	Absent.	„ 22...	...	7	Absent.
„ 6...	...	6	...	„ 23...	...	...	...
„ 7...	7	...	...	„ 24...	...	...	...
„ 8...	...	14	...	„ 25...	20	...	...
„ 9...	14	...	...	„ 26...	...	14	...
„ 10...	...	7	Absent.	„ 27...	14	...	...
„ 11...	9	...	...	„ 28...	...	11	...
„ 12...	...	9	...	„ 29...	18	...	*Present.*
„ 13...	7	...	...	„ 30...	...	10	...

18. *Can other biting Flies (Stomoxys) convey the Trypanosoma found in the Jinja Cattle, Entebbe and Abyssinia Mules to Healthy Animals ?*

Exactly similar experiments to the above were carried out, the only difference being that instead of *Glossina palpalis* another common biting fly met with in Uganda (*Stomoxys*) was used, these experiments are given in full:—

EXPERIMENT 223. MONKEY (*Cercopithecus sp.*).

Feeding biting flies (Stomoxys) on a healthy monkey which had been fed 8 hours before on a monkey infected with the trypanosomes of the "Jinja cattle disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Oct. 11...	7	8	...	Nov. 15...	12	16	...
„ 12...	24	18	Absent.	„ 16...	16	13	...
„ 13 ..	12	22	...	„ 17...	10	18	...
„ 14...	8	10	...	„ 18...	12	26	...
„ 15...	14	16	...	„ 19...	18	12	Absent.
„ 16...	16	24	...	„ 20...	16	14	...
„ 17...	14	16	...	„ 21...	14	12	...
„ 18...	20	18	...	„ 22...	10	12	...
„ 19...	14	17	Absent.	„ 23...	14	22	...
„ 20...	18	15	...	„ 24...	11	10	...
„ 21...	18	18	...	„ 25...	14	12	...
„ 22...	14	12	Absent.	„ 26...	14	0	Absent.
„ 23...	19	14	...	„ 27...	10	12	...
„ 24...	0	0	...	„ 28...	14	30	...
„ 25...	0	0	...	„ 29...	18	20	...
„ 26...	7	6	...	„ 30...	10	11	...
„ 27...	8	6	...	Dec. 1...	12	14	...
„ 28...	7	10	...	„ 2...	14	9	...
„ 29...	8	9	Absent.	„ 3...	14	15	Absent.
„ 30...	12	10	...	„ 4...	16	18	...
„ 31...	14	10	...	„ 5...	11	16	...
Nov. 1...	12	14	...	„ 6...	12	18	...
„ 2...	12	16	...	„ 7...	14	25	...
„ 3...	10	12	...	„ 8...	15	16	...
„ 4...	8	14	...	„ 9...	12	6	...
„ 5...	12	17	Absent.	„ 10...	14	12	Absent.
„ 6...	14	18	...	„ 11...	12	14	...
„ 7...	10	0	...	„ 12...	10	12	...
„ 8...	14	16	...	„ 13...	7	12	...
„ 9...	12	12	...	„ 14...	12	10	...
„ 10...	10	14	...	„ 15...	7	22	...
„ 11...	18	14	...	„ 16...	16	14	...
„ 12...	14	10	Absent.	„ 17...	12	16	Absent.
„ 13...	8	14	...	„ 18...	10	16	...
„ 14...	6	12	...	„ 19...	12	10	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1904.			
Dec. 20...	7	14	...	Jan. 30...	6	8	...
„ 21...	24	16	...	„ 31...	5	4	...
„ 22...	14	20	...	Feb. 1...	4	6	...
„ 23...	8	12	...	„ 2...	6	4	...
„ 24...	12	10	Absent.	„ 3...	4	8	...
„ 25...	...	5	...	„ 4...	4	8	Absent.
„ 26...	10	4	...	„ 5...	11	12	...
„ 27...	12	14	...	„ 6...	8	6	...
„ 28...	12	25	...	„ 7...	5	6	...
„ 29...	9	12	...	„ 8...	6	8	...
„ 30...	7	28	...	„ 9...	16	12	...
„ 31...	12	20	Absent.	„ 10...	12	10	...
				„ 11...	10	6	Absent.
1904.				„ 12...	8	8	...
Jan. 1...	10	20	...	„ 13...	8	4	...
„ 2...	12	6	...	„ 14...	10	15	...
„ 3...	5	13	...	„ 15...	0	0	...
„ 4...	6	10	...	„ 16...	0	0	...
„ 5...	8	10	...	„ 17...	0	0	Absen
„ 6...	18	15	...	„ 18...	...	9	...
„ 7...	10	10	Absent.	„ 19...	...	4	...
„ 8...	10	8	...	„ 20...	4	2	...
„ 9...	5	16	...	„ 21...	6	6	...
„ 10...	9	6	...	„ 22...	8	10	...
„ 11...	15	15	...	„ 23...	10	10	...
„ 12...	12	8	...	„ 24...	9	6	...
„ 13...	18	4	...	„ 25...	5	3	Absent.
„ 14...	6	13	Absent.	„ 26...	5	4	...
„ 15...	6	5	...	„ 27...	4	2	...
„ 16...	10	8	...	„ 28...	6	14	...
„ 17...	5	26	...	„ 29...	8	6	...
„ 18...	6	24	...	Mar. 1...	9	8	...
„ 19...	8	10	...	„ 2...	5	4	...
„ 20...	7	6	...	„ 3...	4	4	...
„ 21...	5	7	Absent	„ 4...	3	3	Absent.
„ 22...	6	4	...	„ 5...	6	6	...
„ 23...	5	7	...	„ 6...	5	4	...
„ 24...	3	4	...	„ 7...	4	3	...
„ 25...	4	6	...	„ 8...	3	2	...
„ 26...	5	5	...	„ 9...	6	5	...
„ 27...	6	4	...	„ 10...	8	5	...
„ 28...	10	3	Absent.	„ 11...	3	6	Absent.
„ 29...	5	5	...	„ 12...	...	4	Stopped.

EXPERIMENT 254. MONKEY (*Cercopithecus sp.*).

Feeding biting flies (Stomoxys) on a healthy monkey which had been fed 24 hours previously on a monkey infected with the trypanosomes of the "Jinja cattle disease."

Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.	
1903.			
Nov. 19...	...	...	Absent.
„ 20...	...	8	...
„ 21...	10	...	...
„ 22...	...	8	...
„ 23...	15	...	...
„ 24...	...	8	...
„ 25...	10	...	...
„ 26...	...	14	Absent.
„ 27...	12	...	...
„ 28...	...	11	...
„ 29...	8	...	...
„ 30...	...	4	...
Dec. 1...	0	...	...
„ 2...	...	24	...
„ 3...	8	...	Absent.
„ 4...	...	10	...
„ 5...	6	...	...
„ 6...	...	4	...
„ 7...	6	...	...
„ 8...	...	5	...
„ 9...	5	...	...
„ 10...	...	4	Absent.
„ 11...	6	...	...
„ 12...	...	4	...
„ 13...	3	...	...
„ 14...	...	8	...
„ 15...	4	...	...
„ 16...	...	6	...
„ 17...	5	...	Absent.
„ 18...	...	5	...
„ 19...	4	...	...
„ 20...	...	4	...
„ 21...	8	...	...
„ 22...	...	5	...
„ 23...	10	...	...
„ 24...	...	2	Absent.
„ 25...	0	...	...
„ 26...	...	0	...
„ 27...	12	...	...
„ 28...	...	15	...
„ 29...	15	...	...
„ 30...	...	15	...
„ 31...	12	...	Absent.
1904.			
Jan. 1...	...	8	...
„ 2...	20	...	...
„ 3...	...	5	...
„ 4...	6	...	...
„ 5...	...	5	...
„ 6...	9	...	...
„ 7...	...	7	Absent.
„ 8...	2	...	...
„ 9...	...	10	...
„ 10...	3	...	...
„ 11...	...	10	...
„ 12...	6	...	...

Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.	
1904.			
Jan. 13...	...	13	...
„ 14...	8	...	...
„ 15...	...	6	Absent.
„ 16...	12	...	...
„ 17...	...	5	...
„ 18...	10	...	...
„ 19...	...	4	...
„ 20...	6	...	...
„ 21...	...	4	Absent.
„ 22...	12	...	...
„ 23...	...	12	...
„ 24...	8	...	...
„ 25...	...	8	...
„ 26...	6	...	...
„ 27...	...	4	...
„ 28...	8	...	...
„ 29...	...	4	Absent.
„ 30...	2	...	...
„ 31...	...	0	...
Feb. 1...	0	...	...
„ 2...	...	8	...
„ 3...	6	...	...
„ 4...	...	4	Absent.
„ 5...	24	...	...
„ 6...	...	8	...
„ 7...	4	...	...
„ 8...	...	4	...
„ 9...	8	...	...
„ 10...	...	14	...
„ 11...	4	...	Absent.
„ 12...	...	4	...
„ 13...	4	...	...
„ 14...	...	8	...
„ 15...	4	...	...
„ 16...	...	8	...
„ 17...	12	...	...
„ 18...	...	4	Absent.
„ 19...	4	...	...
„ 20...	...	8	...
„ 21...	4	...	...
„ 22...	...	4	...
„ 23...	8	...	...
„ 24...	...	4	Absent.
„ 25...	5	...	...
„ 26...	...	8	...
„ 27...	6	...	...
„ 28...	...	4	...
„ 29...	5	...	...
Mar. 1...	...	12	...
„ 2...	6	...	...
„ 3...	...	8	...
„ 4...	8	...	Absent.
„ 5...	...	4	...
„ 6...	5	...	...
„ 7...	...	6	...

EXPERIMENT 205. MONKEY (*Cercopithecus sp.*).

Feeding biting flies (Stomoxys) on a healthy monkey which had been fed 8 hours previously on a monkey infected with the trypanosomes of "Abyssinian fly disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1903.				1903.			
Sept. 27...	...	20	Absent.	Nov. 12...	16	14	Absent.
„ 28...	16	15	...	„ 13...	12	16	...
„ 29...	13	0	...	„ 14...	14	12	...
„ 30...	23	18	...	„ 15...	16	14	...
Oct. 1...	16	23	...	„ 16...	16	11	...
„ 2...	20	11	...	„ 17...	16	14	...
„ 3...	14	20	...	„ 18...	14	12	...
„ 4...	16	12	...	„ 19...	26	24	Absent.
„ 5...	17	20	Absent.	„ 20...	20	10	...
„ 6...	25	18	...	„ 21...	20	8	...
„ 7...	14	23	...	„ 22...	14	18	...
„ 8...	24	18	...	„ 23...	12	10	...
„ 9...	15	12	...	„ 24...	14	8	...
„ 10...	15	20	Absent.	„ 25...	22	16	...
„ 11...	20	14	...	„ 26...	16	14	Absent.
„ 12...	30	28	...	„ 27...	16	20	...
„ 13...	35	30	...	„ 28...	12	15	...
„ 14...	28	24	...	„ 29...	14	10	...
„ 15...	28	14	...	„ 30...	18	10	...
„ 16...	18	14	...	Dec. 1...	14	12	...
„ 17...	20	18	Absent.	„ 2...	10	20	...
„ 18...	14	12	...	„ 3...	12	8	Absent.
„ 19...	10	11	...	„ 4...	14	10	...
„ 20...	16	17	...	„ 5...	22	15	...
„ 21...	14	12	...	„ 6...	18	14	...
„ 22...	18	10	Absent.	„ 7...	22	16	...
„ 23...	12	10	...	„ 8...	18	12	...
„ 24...	12	10	...	„ 9...	14	10	...
„ 25...	12	16	...	„ 10...	12	6	Absent.
„ 26...	9	12	...	„ 11...	6	12	...
„ 27...	12	10	...	„ 12...	9	7	...
„ 28...	14	12	...	„ 13...	9	15	...
„ 29...	10	8	Absent.	„ 14...	16	14	...
„ 30...	16	14	...	„ 15...	12	11	...
„ 31...	18	12	...	„ 16...	12	14	...
Nov. 1...	14	10	...	„ 17...	8	11	Absent.
„ 2...	20	16	...	„ 18...	6	7	...
„ 3...	18	25	...	„ 19...	8	12	...
„ 4...	16	20	...	„ 20...	5	10	...
„ 5...	16	18	Absent.	„ 21...	18	20	...
„ 6...	18	14	...	„ 22...	16	12	...
„ 7...	10	0	...	„ 23...	14	10	...
„ 8...	18	14	...	„ 24...	5	8	Absent.
„ 9...	16	14	...	„ 25...	0	0	...
„ 10...	14	16	...	„ 26...	8	5	...
„ 11...	15	14	...	„ 27...	15	10	...

Date.	Number of flies fed on :— Infected Monkey.	Healthy Monkey.	Tryp.
1903.			
Dec. 28...	16	20	...
„ 29...	10	15	...
„ 30...	8	12	...
„ 31...	13	12	Absent.
1904.			
Jan. 1...	8	6	...
„ 2...	10	8	...
„ 3...	11	12	...
„ 4...	12	6	...
„ 5...	9	10	...
„ 6...	8	4	...
„ 7...	6	3	Absent.
„ 8...	18	3	...
„ 9...	4	4	...
„ 10...	14	7	...
„ 11...	12	6	...
„ 12...	10	4	...
„ 13...	6	5	...
„ 14...	6	4	Absent.
„ 15...	5	7	...
„ 16...	6	4	...
„ 17...	6	14	...
„ 18...	10	5	...
„ 19...	5	9	...
„ 20...	6	6	...
„ 21...	4	4	Absent.
„ 22...	5	3	...
„ 23...	0	6	...
„ 24...	6	5	...
„ 25...	6	5	...
„ 26...	2	4	...
„ 27...	4	3	...
„ 28...	3	2	Absent.
„ 29...	6	4	...
„ 30...	5	4	...
„ 31...	2	0	...
Feb. 1...	4	9	...
„ 2...	3	6	...
„ 3...	4	4	...
„ 4...	2	6	Absent.
„ 5...	8	10	...
„ 6...	6	12	...
„ 7...	6	4	...
„ 8...	8	4	...
„ 9...	11	6	...
„ 10...	8	4	...
„ 11...	12	4	Absent.
„ 12...	6	5	...
„ 13...	6	5	...
„ 14...	6	8	...
„ 15...	16	12	...
„ 16...	4	7	...

Date.	Number of flies fed on :— Infected Monkey.	Healthy Monkey.	Tryp.
1904.			
Feb. 17...	6	8	Absent.
„ 18...	3	6	...
„ 19...	2	3	...
„ 20...	5	5	...
„ 21...	4	5	...
„ 22...	5	4	...
„ 23...	7	7	...
„ 24...	5	8	Absent.
„ 25...	4	6	...
„ 26...	6	8	...
„ 27...	4	6	...
„ 28...	4	2	...
„ 29...	4	3	...
Mar. 1...	4	6	...
„ 2...	4	4	...
„ 3...	6	7	...
„ 4...	5	5	Absent.
„ 5...	4	2	...
„ 6...	4	8	...
„ 7...	3	4	...
„ 8...	6	6	...
„ 9...	3	8	...
„ 10...	6	5	...
„ 11...	5	7	Absent.
„ 12...	6	4	...
„ 13...	8	4	...
„ 14...	5	8	...
„ 15...	4	6	...
„ 16...	5	8	...
„ 17...	14	10	...
„ 18...	14	11	Absent.
„ 19...	8	10	...
„ 20...	5	12	...
„ 21...	10	10	...
„ 22...	14	12	...
„ 23...	10	7	...
„ 24...	6	8	Absent.
„ 25...	4	5	...
„ 26...	8	10	...
„ 27...	4	20	...
„ 28...	14	13	...
„ 29...	7	3	...
„ 30...	6	15	...
„ 31...	1	8	...
Apr. 1...	14	4	...
„ 2...	10	8	...
„ 3...	8	3	...
„ 4...	6	8	...
„ 5...	4	5	...
„ 6...	4	10	...
„ 7...	5	8	Absent.
„ 8...	3	5	...
„ 9...	3	12	...

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
1904.				1904.			
Apr. 10...	10	8	...	Apr. 21...	4	20	...
„ 11...	5	3	...	„ 22...	5	12	Absent.
„ 12...	20	10	...	„ 23...	6	10	...
„ 13...	0	0	...	„ 24...	3	8	...
„ 14...	10	12	Absent.	„ 25...	8	7	...
„ 15...	10	8	...	„ 26...	4	10	...
„ 16...	12	14	...	„ 27...	2	10	...
„ 17...	11	10	...	„ 28...	5	8	...
„ 18...	14	11	...	„ 29...	3	8	Absent.
„ 19...	8	24	...	„ 30...	6	12	Stopped.
„ 20...	14	11	...				

EXPERIMENT 215. MONKEY (*Cercopithecus sp.*).

Feeding biting flies (Stomoxys) on a healthy monkey which had fed 8 hours previously on a monkey infected with the trypanosomes of the "mule disease."

Date.	Number of flies fed on :—		Tryp.	Date.	Number of flies fed on :—		Tryp.
	Infected Monkey.	Healthy Monkey.			Infected Monkey.	Healthy Monkey.	
Oct. 4...	8	18	Absent.	Oct. 24...	0	0	...
„ 5...	13	10	...	„ 25...	7	8	...
„ 6...	12	9	...	„ 26...	25	16	...
„ 7...	14	12	...	„ 27...	20	14	...
„ 8...	12	15	...	„ 28...	16	12	...
„ 9...	5	9	...	„ 29...	14	10	Absent.
„ 10...	20	35	...	„ 30...	14	12	...
„ 11...	28	24	Absent.	„ 31...	12	10	...
„ 12...	28	10	...	Nov. 1...	10	11	...
„ 13...	24	35	...	„ 2...	9	12	...
„ 14...	26	28	...	„ 3...	16	14	...
„ 15...	27	20	...	„ 4...	14	12	...
„ 16...	28	12	...	„ 5...	18	10	Absent.
„ 17...	0	0	Absent.	„ 6...	16	12	...
„ 18...	0	0	...	„ 7...	15	0	...
„ 19...	0	0	Absent.	„ 8...	11	14	...
„ 20...	0	0	...	„ 9...	14	10	...
„ 21...	0	0	...	„ 10...	12	11	Absent.
„ 22...	0	0	Absent.	„ 11...	26	10	Stopped.
„ 23...	0	0	...				

As a result of the above experiments it may be considered proved that the *Glossina palpalis* can convey the above trypanosomes from the sick to healthy animals and so propagate the disease. Apart from the great practical importance attached to this, it is also of considerable interest to note that the *Glossina palpalis* can convey not only the Trypanosoma gambiense, but other varieties. This being so, it is reasonable to suppose also, that other varieties of *Glossina* will convey the Trypanosoma gambiense. This being so, it will be evident from Mr. Austen's map that a very extensive tract of country will be involved. At Igaga's and Kibui, halting places of the Jinja cattle, a variety of tsetse fly (*Glossina pallidipes*) was found.

It may be, further, considered proved that (Stomoxys) cannot convey these trypanosomes from the sick to the healthy animals. This is a matter of great practical importance also, because these flies abound in Uganda.

Some observations were made on the length of time which the various trypanosomes remain active in the stomach of the fly. The contents of the stomach, food reservoirs and salivary glands have been studied both fresh and by staining, but no definite life cycle has been observed in the parasites. In the ventral food reservoir active trypanosomes have been seen up to 12 hours after feeding. This is interesting in view of the fact stated by Schaudinn, that mosquitoes discharge the contents of the sac into the wound, in fact the irritation is produced by these contents.*

Experiments were made to see whether the *Glossina palpalis* can convey any of these varieties of trypanosomes after longer intervals (5 days and over). These remained entirely negative. So it would appear that if the trypanosoma undergoes any transformation in the body of the fly as Schaudinn's work suggests, it must be a short one.

A point of considerable interest in connection with the flies is the tendency which they have to "abort" in captivity. Mr. Austen drew attention to the great variation in size of the pupæ in some specimens sent to him and put forward the above explanation. To test this a number of pupæ have been placed in suitable places and their development noted. It was found that the small undersized specimens underwent no further alteration, whilst the larger and normal looking pupæ hatched out as usual. This would thus suggest that the small pupæ had been prematurely laid and were not viable.

APPENDIX.

In the further report, the histories of a number of cases of sleeping sickness were given ; an additional series have been

* This portion of the investigation, which is very technical, will be elaborated by Professor Minchin, who has gone to Uganda for this purpose.

recorded. In the following cases the special point which has been investigated is the relationship of bacterial invasion to the disease, the frequency and stage of the disease at which it takes place; a more detailed study of the blood is given. Also the results of the examination of the lymphatic glands are given *in extenso*.

The following are the histories:—

Case $\frac{69}{60}$ Sabakaki (Male), Age 8 years.

February 28, 1904. Patient admitted into hospital to-day. Superficial lymphatic glands enlarged. He presents a dull facial expression, with tremors of the tongue and hands. He complains of itching, and there are scratch marks. The pulse is 84, fair.

March 6th. No noteworthy alteration in patient's condition. He is in the late second stage of the disease.

March 15. A gland was excised from the left posterior triangle of neck. The juice contained active trypanosomes, but no diplococci.

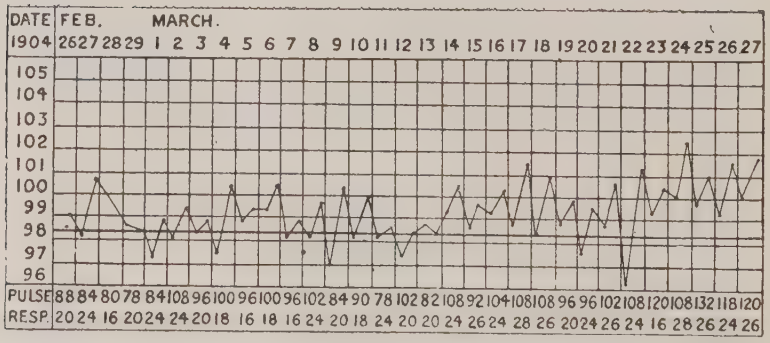
May 15. The general condition of the patient is worse. Pulse 104, tension low. Heart sounds are normal.

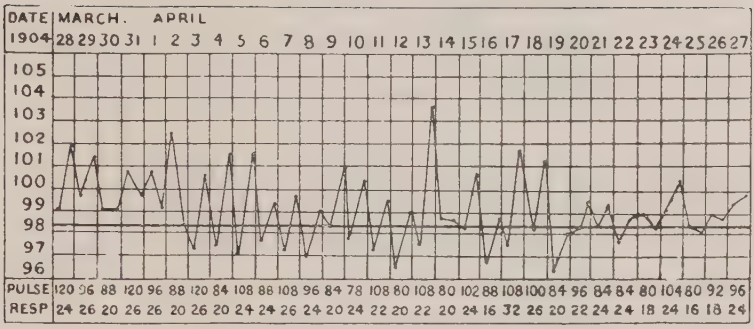
May 27. The patient is passing into the third stage of the disease.

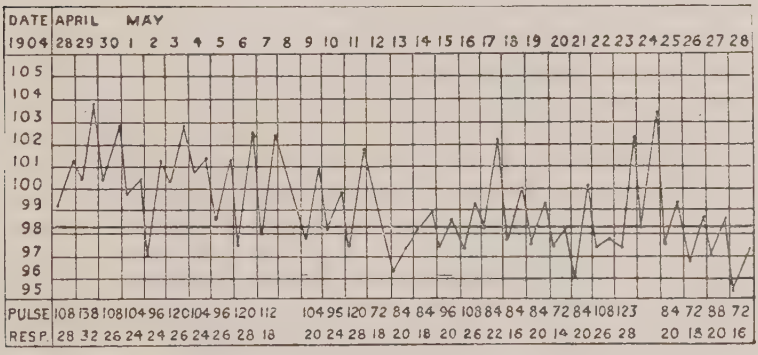
June 6. The patient is now very emaciated and completely bedridden. Jiggers in both feet. The glands in the left posterior triangle of neck were punctured. A tube of broth inoculated with the juice remained sterile. The juice contains many active trypanosomes and also on staining some disintegrating forms. The cerebro-spinal fluid contained active trypanosomes and 94 cells, all mono-nuclear, per c.mm.

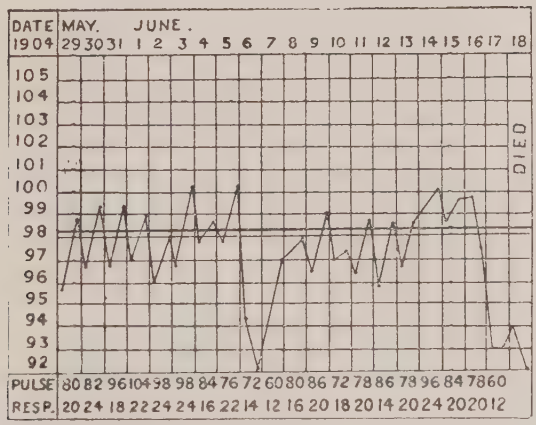
June 14. The patient is moribund.

The following chart represents the course of the disease:—









The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin and the presence or absence of diplococci and trypanosomes in the glands, blood and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
March 15	...	...	32	37	31	...	...	−	+	+	−	−	...	+
June 6	3,700,000	6,800	57	34	9	...	68	−	+	−	−	−	−	+
„ 18	...	...	...	...	...	...	...	−	+	−	−	−	−	...

June 18. Died. Post-mortem.

The body is markedly emaciated. There is general enlargement of the superficial lymphatic glands. There are jiggers in both feet. The pupils are equal and normal. There is no increase of fluid in pleural, pericardial or peritoneal cavities.

On removing the calvarium and reflecting the dura mater some flattening of the convolutions is noticed. There is an increase of sub-arachnoid fluid, giving a dull appearance to the membrane. Spinal cord shows nothing noteworthy to the naked eye. Portions of brain and spinal cord with nerve roots ganglion and nerves were removed for minute investigation. A culture in broth of the cerebro-spinal fluid remained sterile.

Heart.—Shows no noteworthy change. A culture from the blood of this organ shows the presence of B. *coli communis.*

Lungs.—Both show minute areas of embolism scattered throughout, being both subpleural and in the deeper tissue.

Liver.—Shows some congestion.

Spleen.—Distinctly enlarged and pigmented.

Kidneys.—Show no noteworthy change.

Glands.—There is very marked enlargement of both femoral and inguinal groups; these are continuous with a chain which runs along the large vessels of the abdomen towards the thorax; the thoracic group are continuous above with the cervical chain, which extends up to the suboccipital region. No points of suppuration are present in the glands. A culture in broth of the gland juice remained sterile. Stained preparations of the juice showed altered trypanosomes.

Stomach.—Mucous membrane was studded with dark points surrounded by a zone of light red, these petechiæ were more marked towards the pyloric orifice.

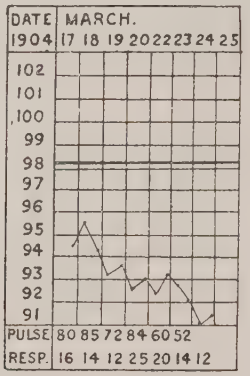
Remarks.—This case is of interest as showing that here there was no invasion by the diplococcus. The B. *coli communis* in this case invaded the tissues probably very shortly before death. This case was therefore one of trypanosoma infection from the beginning to the end. The condition of the lungs was interesting, embolism being a common post-mortem sign in trypanosomiasis of animals.

The condition of the mucous membrane of the stomach was remarkable in this case, compare cases Geerude and Zakayo.

Case $\frac{69}{99}$ Zeridan (Male). Age 16 years.

March 17, 1904. Admitted to hospital. Facies dull and expressionless. Gait is very uncertain. Tremors of hands. Pulse 80, feeble. No œdematous swellings. Lymphatic glands generally are enlarged to a considerable extent. Patient is in the third stage of the disease. Lymph glands were excised from the left posterior triangle of the neck. The juice was examined microscopically and cultures were made in broth and agar from it.

March 20. Patient is now in a moribund condition.
The following chart represents the course of the fever:—



The following table shows the presence or absence of trypanosomes and streptococci in the lymphatic glands and cerebro-spinal fluid, also the total and differential leucocytes count:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1903.														
March 17	...	15,600	45	39	14	2	...	−	+	−	−	−	−	+
„ 24	...	...	...	...	...	...	...	+	+	−	−	+	+	...

March 24. Died. Post-mortem.

The body is covered with a number of blebs containing purulent fluid. No bedsores. The lymphatic glands are generally enlarged.

On opening the body no increase of pleural, pericardial, or peritoneal fluid is found.

Brain.—The sub-arachnoid fluid is increased, giving a dull ground glass appearance. The superficial vessels are injected. The appearance is typical of a sleeping sickness brain. The cerebro-spinal fluid was inoculated into broth and agar tubes, and a pure culture of diplococci was obtained.

Heart.—Normal; a culture in broth and agar from the blood in this organ gave a pure culture of diplococci.

Lungs.—Both normal.

Spleen.—Slightly enlarged, no pigmentation.

Kidneys.—Both rather pale.

Glands.—The juice of the lymph glands examined under the microscope showed the presence of diplococci; no living trypanosomes were seen, but structures which were, probably, broken down trypanosomes.

Remarks.—This case is of interest as showing that the invasion of tissues of this patient by the diplococcus must have occurred just before death, being merely, therefore, a terminal invasion and standing in no causal relation to the disease in this case. The lymph juice examined on March 17 showed the presence of active trypanosomes, but not of cocci, although cultures were made from the glands: the examination of the glands post-mortem, eight days later, showed the presence of streptococci. The heart's blood and cerebro-spinal fluid also contained these.

Case $\frac{69}{RR}$ Abimerika (Male). Age 22 years.

February 27, 1904. Patient was admitted to hospital. He has general enlargement of the lymphatic glands. Facial expression is dull. There are tremors both of tongue and hands.

March 6. The facial expression is duller than before.

March 18. Three superficial glands were excised from the right posterior triangle of neck. Two enlarged glands were also removed from the left femoral region.

Cultures made from the juice in broth and agar remained quite sterile.

April 21. A gland in the left post triangle was punctured—the juice examined microscopically showed active trypanosomes, but no streptococci.

May 15. The facial expression is now very dull. The gait is very uncertain. Heart sounds are weak. There are general tremors of the body. The appetite is good. The pulse is 86; tension low. Patient is passing into the third stage.

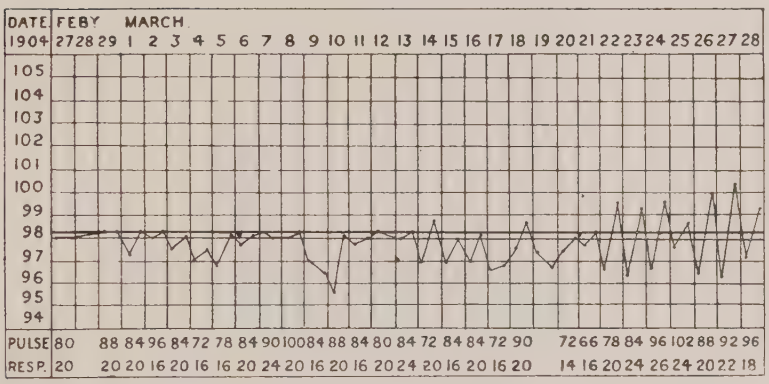
May 27. The patient is distinctly in the third stage. He

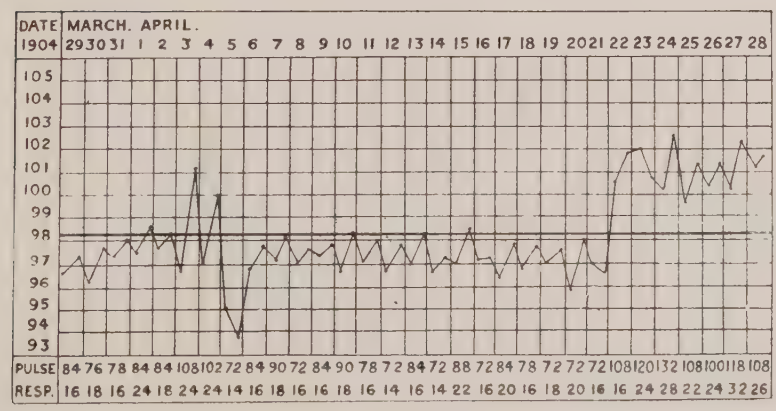
walks with difficulty. The heart sounds are very weak. The tremors of the body are very marked.

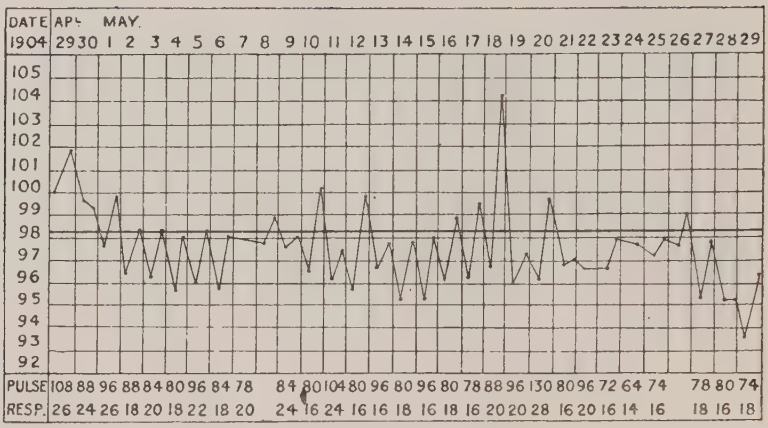
June 4. The glands in the left posterior triangle of neck were punctured. The juice was cultivated in tubes of broth and agar. The examination of the juice under the microscope shows a considerable number of active trypanosomes to be present, also a very large number of round bodies, larger than cocci, which strain blue by Leishman's method, with occasional chromatin dots. No diplococci are present.

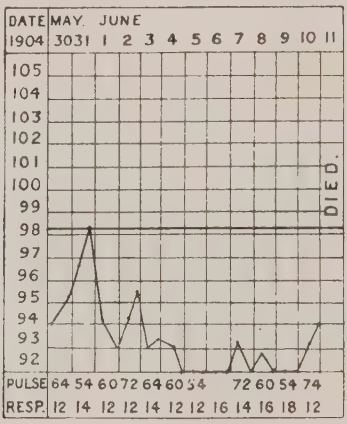
June 5. The broth and agar cultures of the lymph juice are sterile.

The following chart represents the course of the disease :—









The following table shows the result of enumeration of the blood cells, the presence or absence of diplococci and trypanosomes from the lymphatic glands, blood and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
Feb. 27	...	...	...	...	...	...	...	...	...	...	...	...	...	+
March 19	...	8,600	50	27	13	10	...	−	+	−	−	−	...	...
April 11	5,200,000	15,600	22	58	6	14	...	...	...	−	−	−	...	...
„ 21	5,300,000	13.900	29	48	15	13	84	−	+	−	−	−	...	...
May 10	5,000,000	13,700	24	25	43	8	90	...	...	−	−	−	...	...
„ 31	5,000,000	9,370	35	21	28	16	80	...	...	−	−	−	...	..
June 4	5,300,000	10,000	32	27	38	3	90	−	+	-	−	+	...	...
„ 11	...	...	...	...	...	...	...	+	+	-	−	−	...	...

June 11. Died. Post-mortem.

The body is somewhat emaciated. There is general enlargement of the superficial lymphatic glands. Sores, due to jiggers, are present in both feet. The pupils are equal and normal. On dividing the abdominal wall above the pubis a large mass of yellow jelly-like material, which infiltrates between the layers of muscles, is seen. This material under the microscope did not show active trypanosomes. There is no increase of fluid in the pleural, pericardial, or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater some increase of sub-arachnoid fluid is noticed, giving a dull appearance to the membranes, especially towards the base; spinal cord with roots and ganglion removed, along with portions of the brain and glands for minute study.

Heart.—Rather pale, otherwise healthy. Cultures from the blood of this organ made in broth and agar. Both showed a pure growth of a cocco bacillus, probably B. *coli.*

Lungs.—Nothing noteworthy.

Liver.—Congested, otherwise nothing noteworthy.

Spleen.—Shows old perisplenitis; it is enlarged, and on section is seen to be pigmented.

Kidneys.—Nothing noteworthy.

Glands.—All the groups of glands are markedly enlarged, those in the femoral region especially so. In the left femoral region the glands show small points of suppuration—no points of suppuration in the cervical or other glands. The abdominal glands are markedly enlarged and congested on section.

The juice from the cervical glands was inoculated into tubes of broth. The microscopic examination showed no active trypanosomes or diplococci, but some modified trypanosomes were seen in the stained preparations. No growth could be obtained from the juice of the cervical glands in broth.

Remarks.—This case is of interest as showing that the diplococcic invasion was not general: the heart's blood post-mortem showed an invasion by B. *coli communis* and no diplococci. The diplococcic invasion was very localised, being limited to the left femoral group of glands which showed points of suppuration. The other groups showed no cocci.

Case 69, Wasiwa (Male). Age 18 years.

V.V.

January 1, 1904. He presents the usual features of the second stage of sleeping sickness. He is well nourished. There is general enlargement of superficial lymphatic glands. There is marked tremor of tongue. The facial expression is dulled.

February 28. The general condition of the patient shows no noteworthy alteration.

March 26. Lymphatic glands were removed to-day from the left posterior triangle of neck and from right femoral

region. Both the glands contained active trypanosomes. There is some œdematous swelling of the feet.

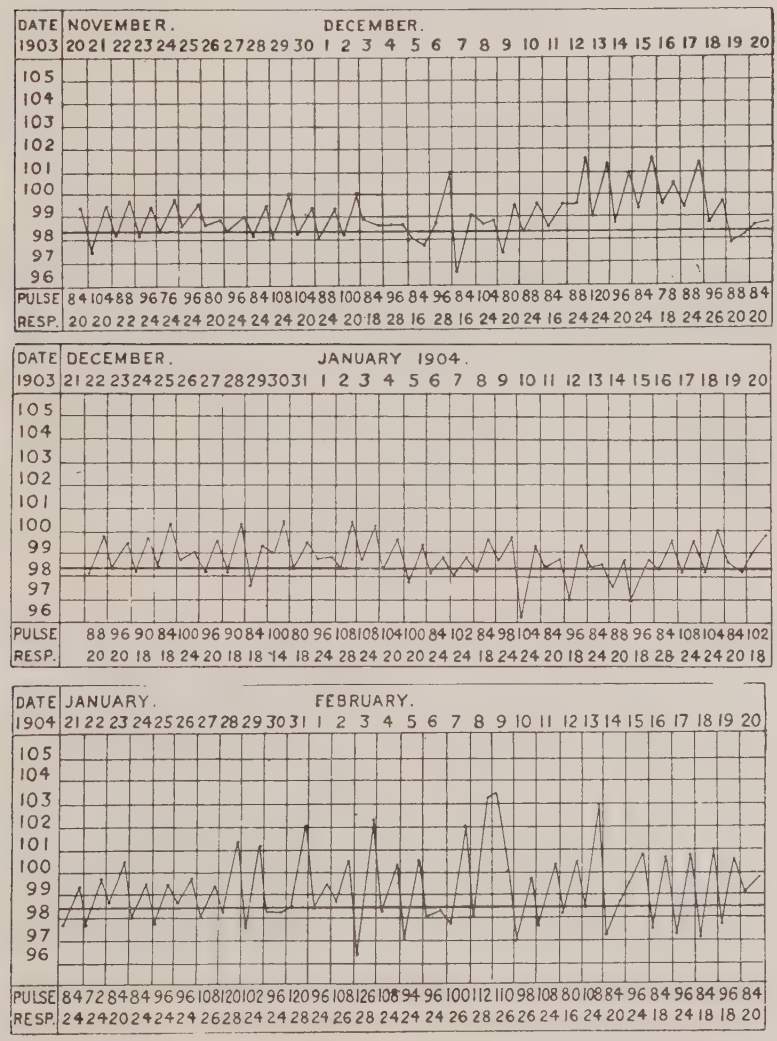
May 15. The expression of face is now very dull. The tremor of his tongue is marked. The appetite is good. The heart sounds are normal. Pulse 84, tension low. Itching of skin is present.

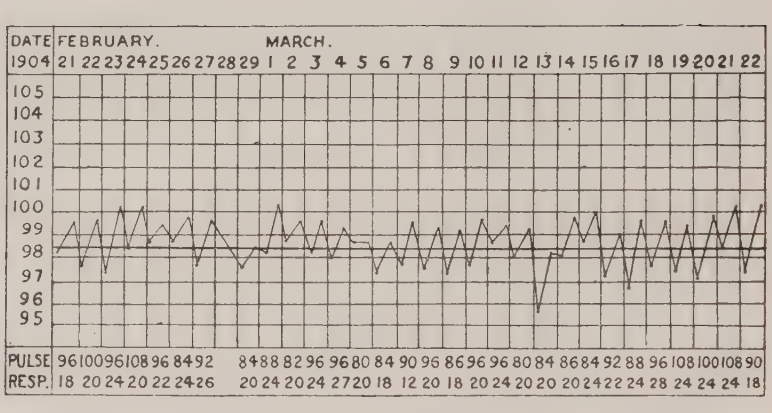
May 27. The general condition shows no noteworthy change.

June 26. The patient is getting gradually weaker. He is now in third stage of this disease.

June 30. The patient is now completely bedridden. A lymphatic gland was excised from the right posterior triangle of the neck. The juice was found to contain active trypanosomes. Cultures were made in agar and in broth; both remained sterile.

The chart shows the course of the disease :—

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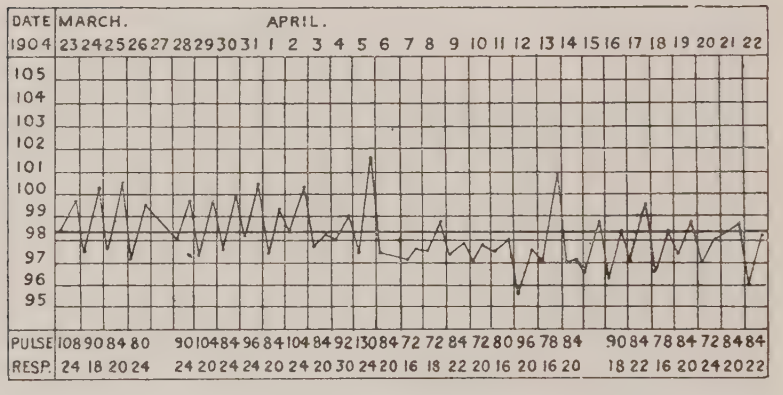
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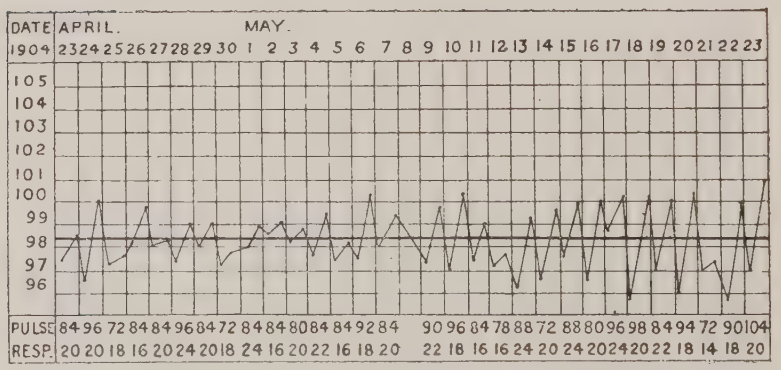
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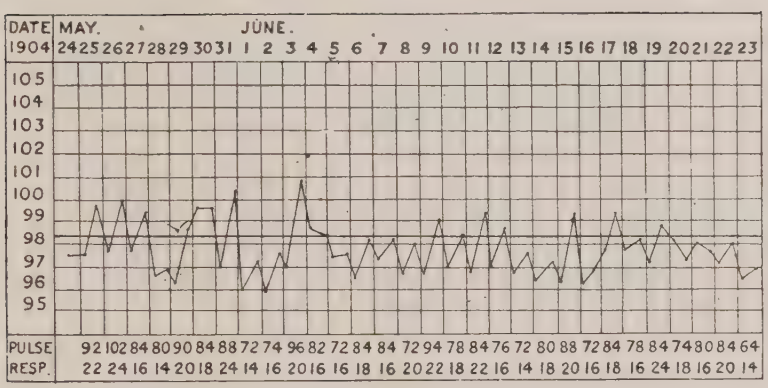
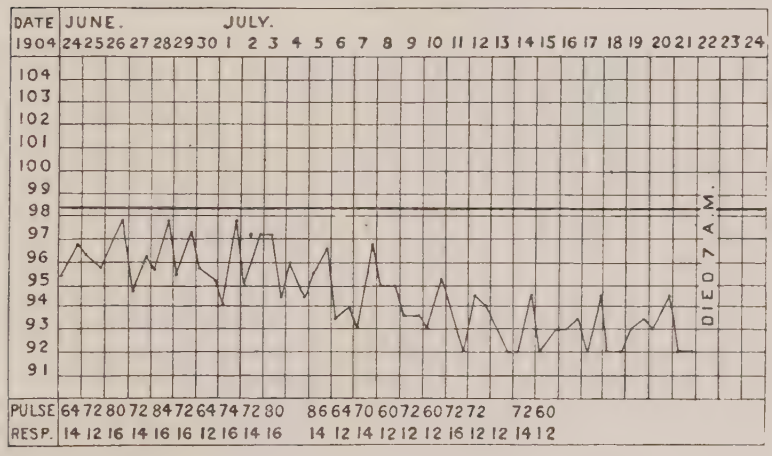




The following table shows the result of enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of streptococci and trypanosomes in the lymphatic glands, blood and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
March 25	...	13,400	49	29	8	14	...	−	+	−	−	−	−	+
April 19	5,300,000	11,200	33	49	9	10	...	...	...	...	...	...	...	...
June 8	5,300,000	10,300	37	40	15	8	94	...	...	...	...	...	...	...
„ 30	5,500,000	11,200	48	44	4	4	92	−	+	+	−	−	...	...
July 16	5,700,000	7,800	52	31	16	1	95	...	...	+	...	−	...	...
„ 22	...	...	...	...	...	...	...	−	+	...	...	...	−	...

July 22. Patient died. Post-mortem.

The body is very well nourished. General enlargement of superficial lymphatic glands. Jiggers in both feet. The wound on right side of neck is not completely healed.

No increase of fluid in the pericardial, pleural, or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater, it is seen that the sub-arachnoid fluid is increased, giving a ground glass appearance to the membranes, the superficial vessels are injected. The ventricles are dilated and there is an increase of fluid in them. The spinal cord presents no noteworthy naked-eye change. Portions of the brain and spinal cord were preserved for minute examination. A culture was made from the cerebro-spinal fluid in broth. This remained sterile.

Heart.—Under the endocardium of the left ventricle several petechiæ are seen to be present. The muscle substance is pale. A culture in broth from the heart's blood remained sterile.

Lungs.—Right is congested, left is healthy.

Liver.—Shows a condition of advanced chronic venous congestion, with fatty changes at the periphery of the lobules.

Spleen.—There is some periplenitis; organ is somewhat enlarged. It is pigmented on section.

Kidneys.—Both show early chronic venous congestion.

Glands.—All the groups are enlarged. The femoral shows points of suppuration (from the sores in feet). No points of suppuration in the cervical glands. A culture in broth from a gland in the left posterior triangle remained sterile. Smears from the cervical glands showed no diplococci. They are present in the femoral glands.

Remarks.—This case again is one of pure trypanosome infection. Streptococci were only present in the enlarged femoral glands, having obtained entrance by the jigger sores.

Case 69 Kirongo (Male). Age 40 years.

W.W.

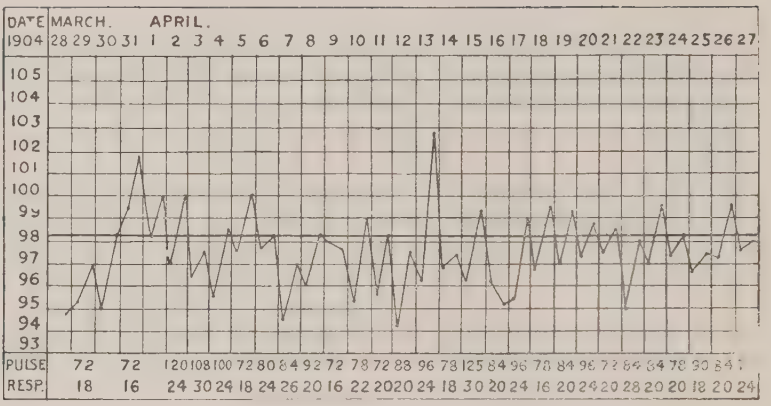
March 23, 1904. The patient looks an old man. He has very distinct general enlargement of lymphatic glands. There are tremors of both tongue and lips. The heart sounds are normal. Pulse 120, weak. Appetite is good. The glands in the right femoral region and also in the left posterior triangle of neck were punctured and in both active trypanosomes were found. No diplococci could be detected microscopically. Cultures in broth from the gland juice remain sterile.

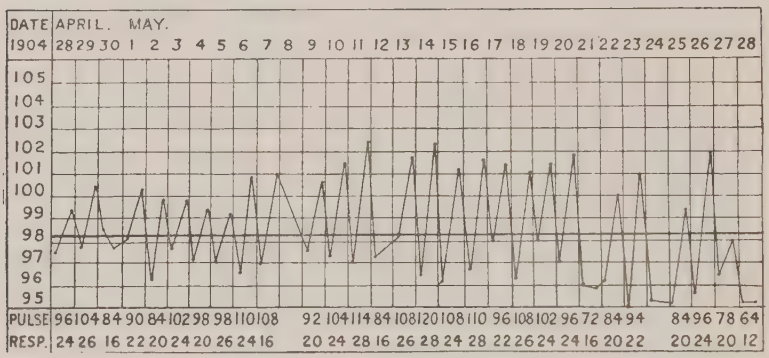
May 15. The wounds in the neck and femoral region, which had suppurated, have now completely healed up. There are jiggers in both feet.

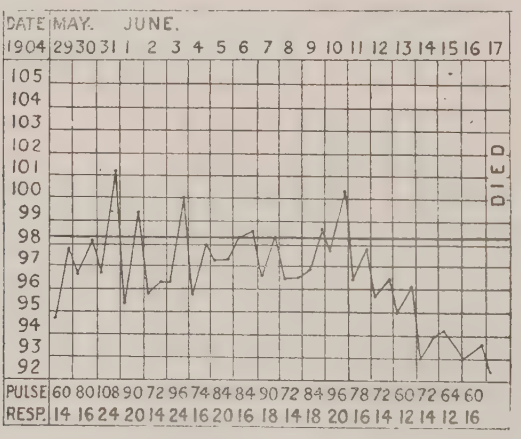
May 27. The patient is now passing into the third stage.

June 12. The condition of patient is more pronounced. He is definitely in the third stage.

The following chart shows the course of the disease:—







The following table shows the result of enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of diplococci and trypanosomes in the lymph glands, blood and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
March 28	...	6,400	51	35	10	4	...	-	+		-	−	...	+
April 25	4,900,000	17,800	25	50	17	8	82	...	...	...	...	...	...	+
„ 12	5,400,000	7,800	54	37	4	5	...	...	...	...	...	...	...	...
June 14	4,400,000	16,200	30	41	15	14	84	...	...	...	...	...	+	...
„ 17	...	...	...	...	...	...	...	...	...	...	...	...	+	...

June 16. Patient died. Post-mortem.

There is a general enlargement of superficial lymphatic glands. Sores in both feet due to jiggers. There is not much emaciation. The pupils are equal and normal. No increase of fluid in the pleural, pericardial, or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater the sulci are seen to be filled up with a turbid exudation. The superficial vessels are injected. Towards the base of the brain the exudation is more marked. The lateral ventricles are dilated and there is an increase of cerebro-spinal fluid. The spinal cord shows nothing noteworthy. Portions of the nervous system removed for further examination.

The exudation examined microscopically shows the presence of diplococci; a culture made in broth and agar showed a fine growth, probably pneumococcus.

Heart.—Old endocarditis of mitral valve present, otherwise nothing noteworthy. A culture in broth from the blood of this organ was made and showed the presence of the *bacillus coli communis.*

Lungs.—Both apparently healthy.

Liver.—Adherent in places to diaphragm. On section it shows a condition of chronic venous congestion with commencing cirrhosis.

Spleen.—Somewhat enlarged and very markedly adherent to surrounding parts. The capsule is thickened.

Kidneys.—Both show a condition of chronic venous congestion.

Glands.—Deep cervical and suboccipital are markedly enlarged. They were removed along with cervical nerves for minute investigation.

Remarks.—This case is of interest as showing that although the patient was in a late stage of the disease at the time of examination no diplococci were present in the glands, but many active trypanosomes were found. On post-mortem examination a diplococcus was observed in the exudation in the brain. This must have occurred at a late stage of the disease, when the patient was practically moribund.

Case 69 xx. Zumageza (Male). Age 18 years.

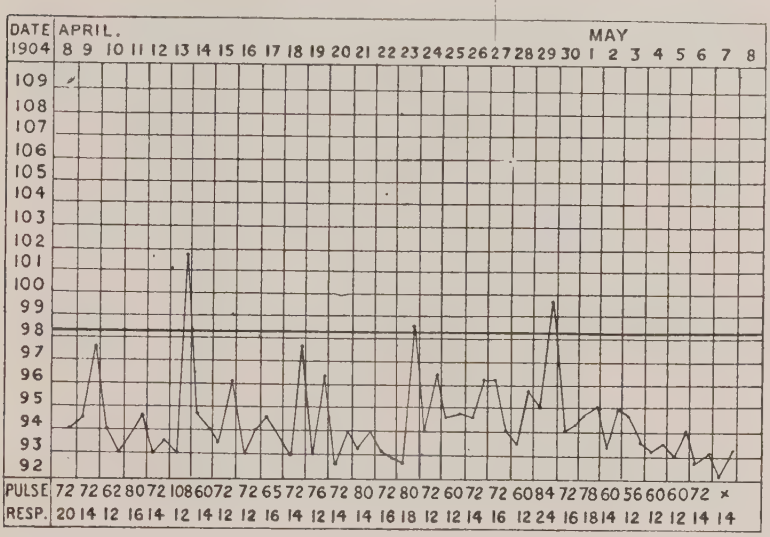
April 9, 1904. Admitted into hospital, sent by Dr. J. H. Cook. Patient presents a markedly dull facies and tremors of tongue; lymphatic glands are generally enlarged. He has a chronic synovitis of right wrist. A gland in the left posterior triangle of neck was punctured and the juice examined microscopically showed active trypanosomes; no streptococci could be seen in stained films of the juice. 10 c.c. cerebro-spinal fluid placed in broth; it remained sterile.

April 20. Punctured cervical glands again.

April 30. Patient is getting distinctly worse and is in the third stage of the disease.

May 8. Died to-day.

The following chart represents the course of the disease:—



The following table shows the presence or absence of trypanosomata and streptococci in the blood, lymphatic glands, and cerebro-spinal fluid, also the results of the red and white blood corpuscles:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in blood.			Parasites in glands.		Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Fil.	Mal.	Tryp.	Strept.	Tryp.	Strept.	Tryp.
1904.														
April 9	...	9,300	50	40	9	1	...	–	–	–	–	+	–	+
„ 20	4,200,000	8,000	57	31	12	0	65	–	–	–	–	+	...	...
May 8	...	...	...	...	...	...	...	...	...	...	+	+	...	...

May 8. Post-mortem.

The body is not emaciated, there is general enlargement of the superficial lymphatic glands. Right wrist is swollen and there is a fistulous opening over the ulna leading down to bone. On exposing the joint, the articular surface of the ulna and sarpal bones were seen to be eroded and ulcerated. The synovial membrane was in a jelly-like condition. On opening the body there was no increase of fluid in the pleural, pericardial or peritoneal cavities.

Brain.—Some increase of sub-arachnoid fluid. The pia mater looks like ground glass and the sulci are filled with fluid. There is some injection of the superficial vessels. Spinal cord shows nothing noteworthy to the naked eye. Portions with roots and ganglion attached as well as parts of the brain and glands were removed for minute investigation.

Heart and Lungs.—Nothing noteworthy, naked eye.

Liver.—Shows congestion.

Spleen.—Enlarged, pigmented and firm on section.

Glands.—Cervical and suboccipital were markedly enlarged and congested. They formed a continuous chain from the cranium to the thorax following the course of the main vessels. Small points of suppuration are seen on section. Examined microscopically the lymphatic glands are seen to contain diplococci and broken down trypanosomes.

Remarks.—This is an ordinary case of sleeping sickness. It is of interest to note that when juice from the enlarged glands of the neck was examined less than a month before death, when the disease was in its last stage, the only parasites seen to be present were trypanosomes; no streptococci were observed at that date. However, 18 days later minute points of suppuration were found in the glands, and diplococci invaded the tissues probably just before death and could have played, therefore, no part in the causation of the symptoms which are met with in an advanced case of sleeping sickness.

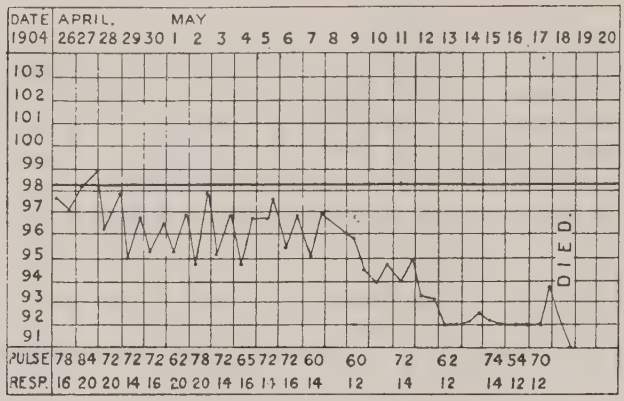
Case $\frac{69}{22}$ Usmani (Male). Age 20 years.

April 25, 1904. Admitted to hospital. Glands in the right anterior triangle of neck were punctured.

May 9. Patient is practically bed-ridden, being unable to walk. The superficial glands are generally enlarged. The facies is dull and heavy. He sleeps frequently. The glands were punctured in the right anterior triangle of neck. 10 c.c. cerebro-spinal fluid placed in broth; it remained sterile.

May 15. The patient is now in a moribund condition. He sleeps constantly.

The following chart represents the course of the disease:—



The following table shows the result of the enumeration of the blood cells and the presence or absence of streptococci and trypanosoma in the lymphatic glands, blood, and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
April 25	4,400,000	10,300	23	44	23	10	78	−	+	−	−	−	...	...
May 9	4,600,000	7,500	45	25	16	14	75	−	+	−	−	−	−	+
„ 19	5,600,000	20,600	77	6	17	0	110	−	+	...	...	...	...	...

May 19. Died. Post-mortem.

The body is somewhat emaciated. The superficial glands are generally enlarged.

On opening the body there is no increase of fluid in the pleural, pericardial, or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater some increase of sub-arachnoid fluid was noticed, giving a dull appearance to the membranes. No streptococci were detected in film smears. Portions of brain and spinal cord were preserved for minute investigation.

Heart.—Nothing noteworthy.

Lungs.—Healthy.

Liver.—Some old adhesions over the surface and about the gall-bladder, on section nothing noteworthy.

Spleen.—Distinctly enlarged; the juice examined microscopically showed no streptococci.

Kidneys.—Both normal.

Lymphatic glands.—Mesenteric are distinctly enlarged. The deep cervical are markedly enlarged; on section to the naked eye show no points of suppuration. The expressed juice examined under the microscope in the fresh and stained specimens showed no active trypanosomes in the former, in the latter altered trypanosomes, but no streptococci could be seen.

Remarks.—The examination of this patient's glands about 24 hours before death showed the presence of active trypanosomata, but no streptococci. Further, in this case an investigation of the juice of the various organs post-mortem showed that the streptococci were not present. No points of suppuration were seen on section of the glands. This was a case of pure trypanosoma infection from first to last with no terminal invasion. The red blood corpuscles rose in this case to 5,600,000 per mm^3., the percentage of hæmoglobin to 110.

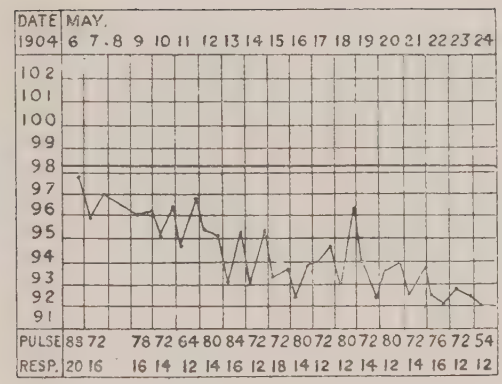
Case $\frac{69}{G.T.}$ Masake (Male). Age 16 years.

May 6, 1904. Patient admitted to hospital. The lymph glands in the right posterior triangle of neck were punctured and juice drawn off. 10 c.c. cerebro-spinal fluid placed in broth; it remained sterile.

May 7. Patient lived at Buganga near Entebbe. States he has been ill one month. On examination he presented a dull facial expression with tremors of hands. The lymphatic glands were generally enlarged. Pulse 88. Heart sounds normal. Spleen slightly enlarged. Liver not enlarged.

May 15. The patient is distinctly in the third stage of the disease. His gait is ataxic. Expression of face is very dull. General tremors of body are present.

The following chart represents the course of the disease :—



The following table shows the result of the blood corpuscle enumeration, the presence or absence of streptococci or trypanosoma in the glands, blood and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in the blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
May 6	4,050,000	9,060	49	17	25	9	75	−	+	−	−	+	−	+
„ 7	...	...	...	...	...	...	...	−	+	...	...	−	...	...
„ 9	...	...	...	...	...	...	...		+	...	...	−	...	...
„ 11	...	...	...	...	...	...	...	...	...	...	...	−	...	...
„ 13	...	...	...	...	...	...	...	...	...	...	...	−	...	...
„ 24	...	...	...	...	...	...	...	−	+	...	...	...	...	...

May 24. Died. Post-mortem.

The body is not much emaciated. The superficial glands, especially in the axilla, are distinctly enlarged. In the groin and axilla they are extremely congested, and some even show small areas of hæmorrhage, though no points of suppuration can be seen in any of the glands.

On opening the body no increase of fluid in pleural, pericardial or peritoneal cavities is seen.

Brain.—On removing the calvarium and reflecting the dura mater some increase of sub-arachnoid fluid is seen. The pia mater has a ground-glass appearance. Some injection of superficial vessels.

Heart.—Nothing noteworthy.

Lungs.—Both show hypostatic congestion at posterior surface.

Liver.—Shows early cirrhosis.

Spleen.—Slightly enlarged, firm on section, not pigmented.

Kidneys.—Both healthy.

Glands.—Culture was made from the right cervical glands in broth; this remained sterile, no diplococci could be seen under the microscope. No active trypanosomes were seen, but broken down forms were noted in the stained specimens.

Remarks.—This was a fairly active case. The examination of the lymph juice *intra vitam* on May 6 showed the presence of active trypanosome, but no streptococci.

On post-mortem examination of the glands no diplococci could be cultivated from the cervical glands, altered trypanosomes were seen in the stained specimens.

Sections of the various organs were made and stained for micro-organism; no diplococci or other bacteria were observed. This was a case of pure trypanosoma infection.

Case 69 F.V. Hamisi (Male). Age 12 years.

May 5, 1904. The patient was admitted into hospital today.

May 7. He states that he has been sick for about one month. He lives in a shamba near the Lake close to Entebbe. His food is bananas and potatoes. He had headache at the beginning of the illness. He presents now a heavy dull facial expression. No tremor of hands—slight tremor of tongue. The knee jerks are normal, no ankle clonus. The superficial lymphatic glands are generally enlarged. His pulse is 108.

Heart.—Sounds normal.

Lungs.—Normal.

Liver.—Is not enlarged.

Spleen.—Extends to the costal margin.

May 15. The general condition shows no alteration. He is somewhat excited.

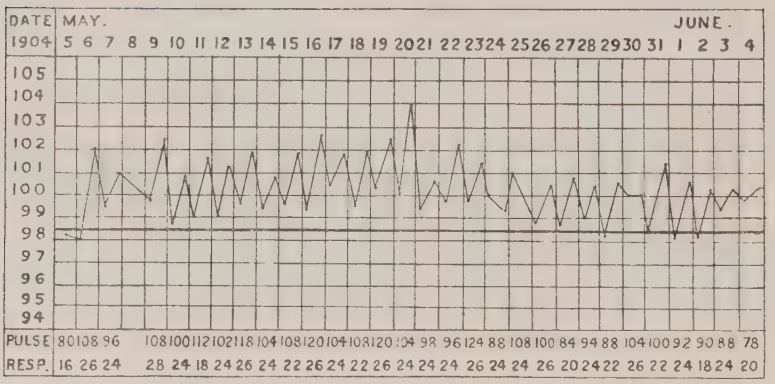
May 27. The patient is distinctly in the second stage of the disease.

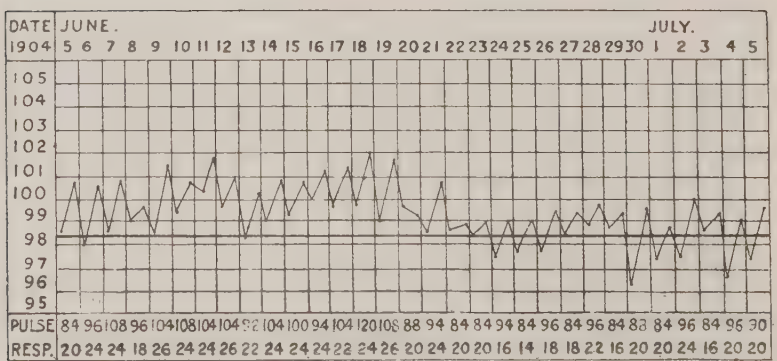
June 12. The gait is now uncertain and halting. His facial expression is markedly dull—otherwise no noteworthy alteration in the condition of the patient.

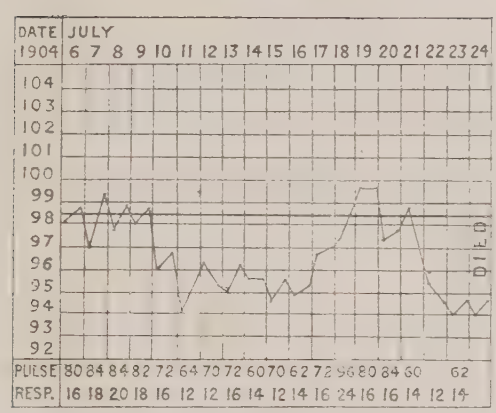
June 23. The general condition of patient shows marked signs of deterioration.

July 12. The patient is distinctly in the third stage of the disease and is completely bedridden. The lymphatic glands in left posterior triangle were punctured and tubes of broth and agar were inoculated; both remained sterile. The juice contained many active trypanosomes. A drop of the juice was mixed with an equal quantity of 1:1,000 solution AS_2O_3. The trypanosomes ceased moving at the end of 12 minutes, although those in the control continued actively motile.

The following chart shows the course of disease :—







The following table shows the results of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of trypanosomes and streptococci in the glands, blood and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in the blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
May 5	3,800,000	13,700	52	27	16	5	64	−	+	−	+	+	−	+
„ 16	4,000,000	5,300	35	32	28	5	60	...	...	+	+	+	...	...
„ 19	...	8,740	31	37	22	10	...	...	...	+	+	+	...	...
June 16	5,200,000	13,000	50	34	11	5	78	...	...	−	+	+	...	...
„ 22	...	...	49	36	12	3	...	...	...	...	+	+	...	...
„ 23	...	...	...	...	...	...	...	...	...	...	...	+	...	...
July 12	5,000,000	18,000	54	32	13	1	78	−	+	+	+	+	...	...
„ 20	5,400,000	38,100	65	24	11	...	84	...	...	+	+	+	...	...
„ 24	...	...	...	...	...	...	...	+	...	...	...	...	+	...

July 24. Patient died. Post-mortem.

The body is markedly emaciated. Jiggers present in both feet and hands. The pupils are equal and normal.

There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater, the convolutions are seen to present the usual appearance of a sleeping sickness brain. The sub-arachnoid fluid is considerably increased, giving the usual ground glass-like appearance to the membrane. This is more marked towards the base. The superficial vessels are injected. The lateral ventricles are dilated. The substance of the brain shows points of congestion throughout the white matter. Portions of brain, spinal-cord nerve roots and nerves removed for further examination. A culture in broth from the cerebro-spinal was made, which showed a pure growth of diplo-streptococci.

Heart.—Pale and flabby, all the cavities are dilated. A culture in broth from the heart's blood was made, which showed a pure growth of diplo-streptococci.

Lungs.—Left is adherent throughout the whole extent. The adhesions are fairly easily broken down, and are of fairly recent date; the lung is partially collapsed. The pericardium and heart are partially drawn to the left side. The right lung is normal.

Liver.—Shows a condition of chronic venous congestion.

Spleen.—There is some old perisplenitis and a scar across the organ near its centre. On section the substance is congested and shows old malarial pigmentation.

Kidneys.—Both show early chronic venous congestion.

Glands.—All the groups are enlarged and congested. Both femoral groups show points of suppuration. In the left cervical group near suboccipital triangle a deeply placed gland shows several points of suppuration. A culture was made in broth from a gland in the left cervical region showing no points of suppuration.

Remarks.—This is another very interesting case. Although the gland juice was examined so late as 12 days before death no streptococci were detected, but the juice contained a very large number of active trypanosomes. On post-mortem examination we find not only the femoral group of glands suppurating but also the deeply placed glands in the neck. In this case, therefore, the invasion by the diplococcus was purely terminal, probably it gained entrance through the many suppurating abrasions occasioned by the jiggers. The vitality of the patient also having become greatly lowered, the glands nearest the seat of infection, viz., the femoral and axillary, were unable to deal with the germ, and so it became generalized.

CASE 69, K.P. ARCADI (MALE). AGE 25 YEARS.

May 17, 1904. The patient lives at the Swahili village, Entebbe. He has been headman to one of the Indian traders at Entebbe. He is at present a prisoner. He states he has been sick for six months. He now presents a dull heavy facial expression. He has slight tremors of the tongue. There is no headache or itching of the skin. The pulse is 100; tension fair. His superficial lymphatic glands are generally enlarged.

May 27. Opened a small abscess at root of toes of left foot His general condition is unchanged.

June 1. A gland in the left posterior triangle of neck was punctured. The juice contained a large number of active trypanosomes. Some of the juice was planted on a tube of blood agar; this remained sterile. He is in the late second stage of the disease.

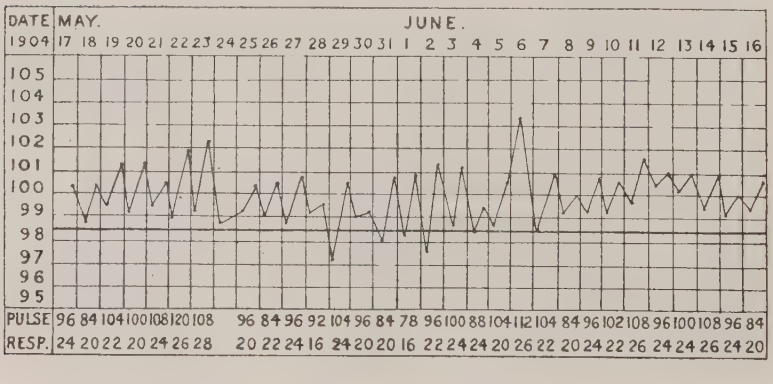
July 14. Patient's condition has deteriorated considerably. He has general tremors of the body, and the facial expression is very dull. A gland in left posterior triangle of neck was punctured, and the juice was seen to contain active trypanosomes in very large numbers. Tubes of broth and agar were inoculated from the juice. Both showed a pure culture of a diplococcus next day.

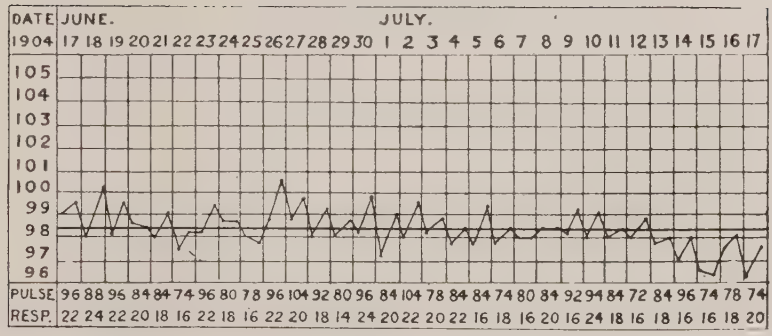
July 15. The tremors are now general, but more marked on the right side of the body. His speech is very indistinct. He does not complain of pain. The knee jerks are both present but somewhat diminished. Ankle clonus is present. Heart sounds are normal, no brûit.

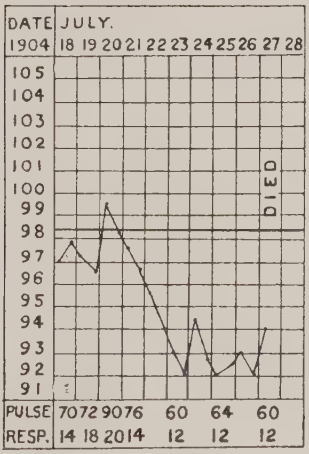
July 19. The patient is now unable to speak. The tremors are well marked. He is considerably emaciated.

July 21. The patient is now practically moribund. Jiggers present in both feet.

The following chart shows the course of the disease :—







The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of diplococci and trypanosomes in the glands, blood, and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
May 17	5,100,000	17,000	35	34	29	2	84	−	+	−	−	+	−	+
June 1	...	...	...	...	...	...	...	−	+	...	...	...	...	...
July 14	6,000,000	14,800	46	36	11	7	100	+	+	−	−	+	...	...
„ 19	6,000,000	12,500	55	33	9	3	102	+	+	+	−	+	...	...
„ 21	6,020,000	14,300	50	43	5	2	102	+	...	...	...	...	...	...
„ 27	...	...	...	...	...	...	...	+	+	...	...	...	+	...

July 27, 1904. Patient died. Post-mortem.

The body is that of a well-built man. There is considerable emaciation. The pupils are equal and normal. There is general enlargement of superficial lymphatic glands.

There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater, the superficial vessels are seen to be infected. There is an increase of the sub-arachnoid fluid, giving a ground glass appearance to the membranes. The ventricles are dilated. The spinal cord presents no noteworthy naked eye change. Portions of nervous system preserved for future examination.

Heart.—All the cavities are dilated ; the muscle wall is pale and flabby. There are no petechiæ ; a tube of broth inoculated with the blood of this organ showed a pure culture of diplococci.

Lungs.—Both normal.

Liver.—Some fairly recent adhesions between the liver and the diaphragm. The substance shows typical nutmeg condition.

Spleen.—Some fairly recent adhesions and old perisplenitis. On section it is congested, and shows old malarial pigmentation.

Kidneys.—Nothing noteworthy.

Glands.—There is very marked enlargement of the cervical glands, and some of the deep ones in this region showed points of suppuration. The other groups of glands were also markedly enlarged ; a tube of broth was inoculated from a gland in the suboccipital region, and showed a pure culture of diplococci.

Stomach.—The mucous membrane presented a curious condition, it was studded with minute hæmorrhagic areas ; these areas had a dark centre of altered blood and a peripheral zone of light red ; there were also a few larger areas. No ova of Bilharzia were seen in the scrapings.

Remarks.—This is an interesting case. It showed during its course a remarkable number of trypanosomes in the glands, blood, and cerebro-spinal fluid. The trypanosomes were found in the cerebro-spinal fluid without centrifuging. Cultures were made from the lymphatic glands on June 1, these remained sterile : very many active trypanosomes were present in the juice. On July 14 cultures made from the lymphatic glands showed a pure culture of diplococci. Here again we had a case with all the classical signs of an advanced stage of the disease at the date of examination of the glands, and although many trypanosomes were present, no diplococci were found. The invasion by diplococci did not occur until the patient was in practically a moribund condition. The number of red blood corpuscles rose before death to 6,020,000 per mm.^{3}, and the percentage of hæmoglobin at the same time rose to 102. The condition of the mucous membrane of the stomach was very interesting in this case.

The following photographs show the enlargement of the lymphatic glands in case of No. 69 ZN. Arcadi on June 5, 1904 :—

Case 237. Sempagama (Male). Age 8 years.

October 29, 1903. Patient admitted to hospital. He lives in Entebbe near the shore of the Lake. He complains of pains all over his body. The patient presents a heavy dull facial expression, and his voice is somewhat weak. There is no tremor of the tongue or fingers. The knee joints are normal. The spleen is slightly enlarged. The pulse is 84, weak. The heart sounds are normal.

December 29. The general condition is now more marked. There are now general tremors of the body.

February 28, 1904. The patient is getting thinner, and generally shows signs of progressive deterioration of health.

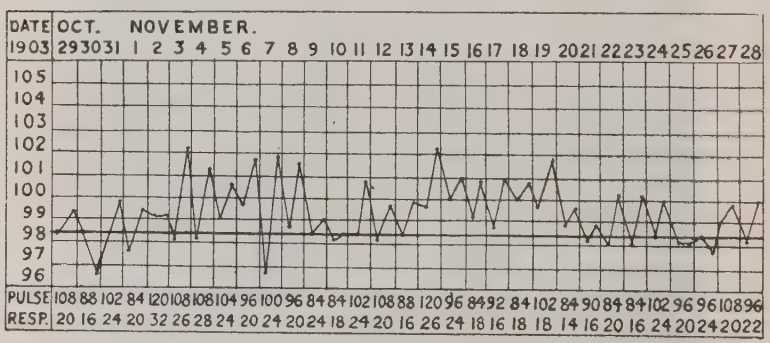
March 2. The glandular enlargement is general, and well marked.

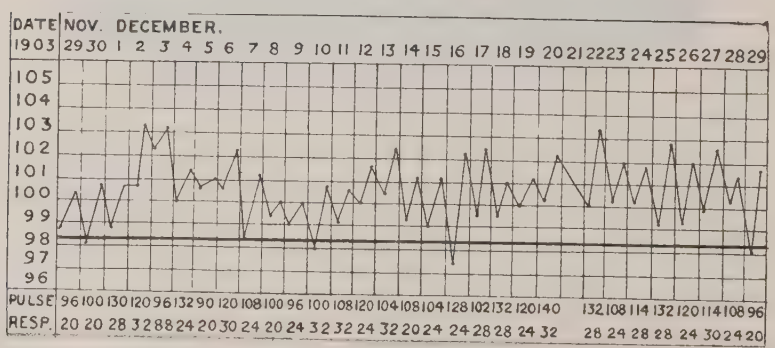
March 14. A gland in the right posterior triangle of the neck was excised.

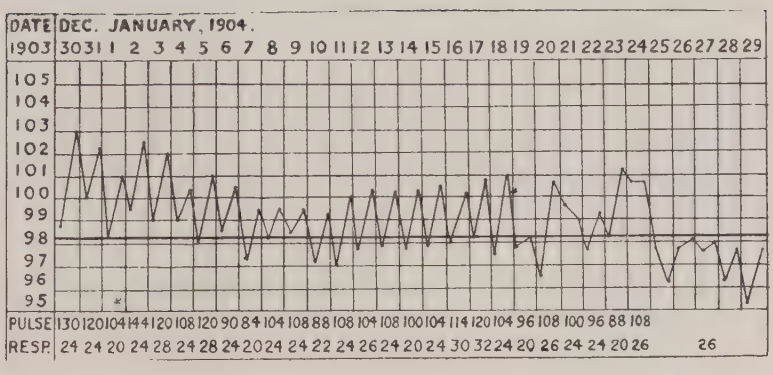
May 27. The patient is now extremely emaciated. He lies doubled up in bed, and is asleep the whole day. The voice is very feeble.

June 5. The patient is reduced to mere skin and bone. The glands in the left posterior triangle of neck were punctured. The juice was examined microscopically, and cultures on agar were made. 10 c.c. cerebro-spinal fluid was placed in broth; it remained sterile.

The following chart shows the course of the disease :—



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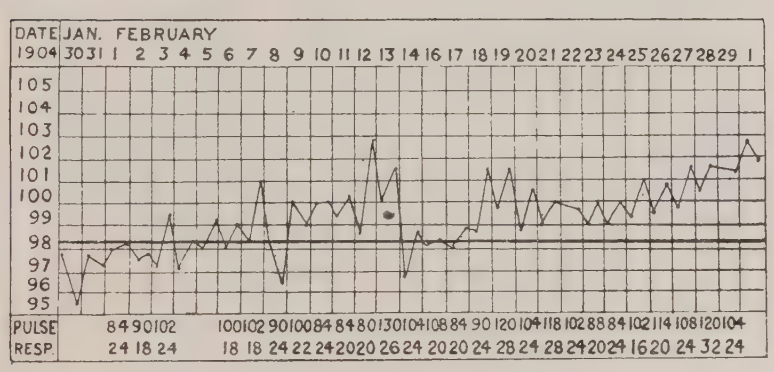
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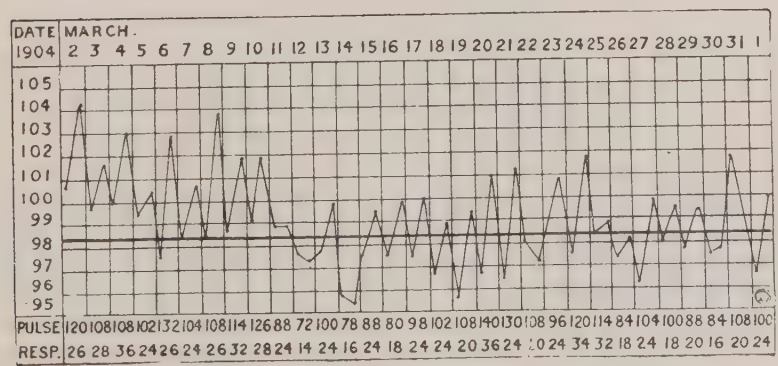
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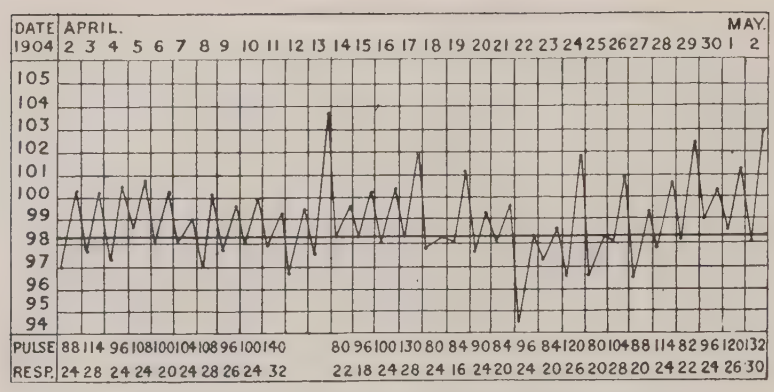
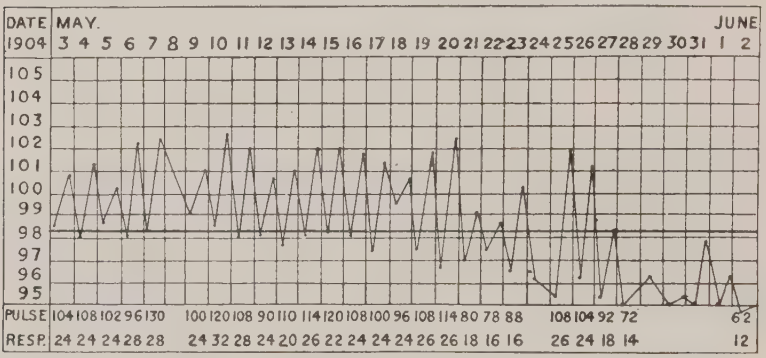
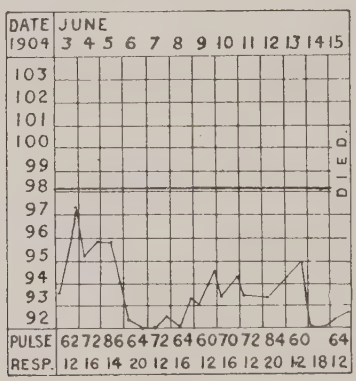






The following table shows the result of enumeration of the blood corpuscles, and the presence or absence of the trypanosoma and diplococcus in the lymphatic glands, blood and cerebro-spinal fluid.

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
Oct. 29	...	...	...	...	...	...	...	...	...	...	...	...	−	+
March 14	...	...	...	...	...	...	...	−	+	+	−	−	...	...
„ 16	...	...	53	33	14	...	...	...	...	...	...	...	...	...
June 2	4,350,000	10,900	62	16	11	11	70	...	...	−	−	+	...	...
„ 5	4,400,000	10,100	33	45	19	3	72	−	+	−	−	+	−	+
„ 15	3,600,000	74,680	42	43	15	0	70	−	+	−	−	+	−	+

June 15. Died at 12.30 p.m. Post-mortem one hour later. The body is greatly emaciated. The superficial lymphatic glands are generally enlarged. The pupils are equal and normal. There are many jiggers in both feet. There is no increase of fluid in pleural, pericardial or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater the surface of the left hemisphere, corresponding to the parietal eminence, is seen to be covered with a clot of blood, no fracture of calvarium was present. There is some increase of sub-arachnoid fluid. The pia-mater had the usual ground glass appearance. On section nothing noteworthy was observed. Spinal cord showed nothing noteworthy to the naked eye. Portions of the brain, spinal cord, ganglia and nerves preserved for minute investigation. The cerebro-spinal fluid was examined one hour after death, and contained active trypanosomes.

Heart.—Showed nothing noteworthy. The blood from this organ was examined microscopically and many trypanosomes were present. A culture in broth and agar was made from the heart's blood; these showed a growth of *Bacillus coli communis.*

Lungs.—Some old adhesions over the lower lobe of both lungs, otherwise nothing noteworthy.

Liver.—Appears healthy.

Spleen.—Considerably enlarged; shows old perisplenitis, with thickening of capsule; the substance is pigmented.

Kidneys.—Nothing noteworthy.

Glands.—There is considerable enlargement of the abdominal glands and those in the cervical region. The femoral group were markedly enlarged and showed points of suppuration. The axillary group were also enlarged, but showed no points of suppuration. A culture was made from a group of enlarged glands in the left cervical region in broth; this remained sterile.

Remarks.—This case was a very chronic one. The trypanosomes were present in considerable numbers in the gland juice; they were also seen in films of the peripheral blood. There was a remarkable increase of the total leucocytes before death. No diplococci could be determined in the lymph juice *intra vitam* nor in the heart's blood or glands post-mortem. The terminal invasion was in this case *Bacillus coli communis.* This must have occurred during life, as the post-mortem was made within an hour of death.

Case 69 Z.D. Usmani (Male). Age 14 years.

May 25, 1904. Patient comes from Usoga. He has been working as a boy in Entebbe. There are tremors of hands and body generally. He is not able to stand. The lymphatic glands are generally enlarged. Facial expression is markedly dulled. Heart sounds normal. Pulse is 76. Liver and spleen are enlarged. The glands in left posterior triangle were punctured and living trypanosomes obtained. The examination

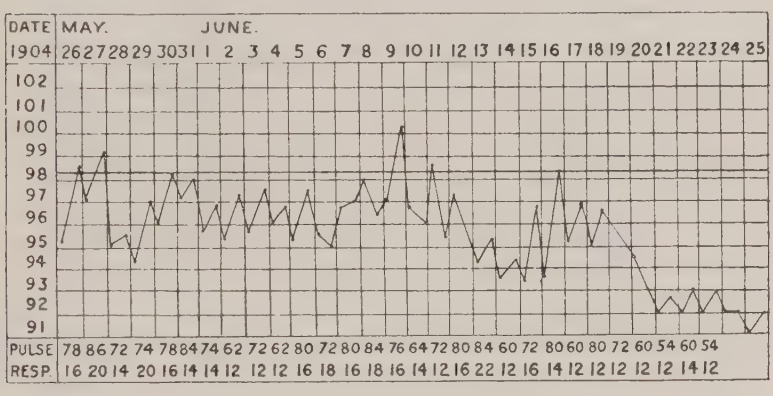
of the cerebro-spinal fluid showed the presence of disintegrating trypanosomes as well as actively motile one. The fluid contained 670 corpuscles per mm.^{3}, all being mono-nuclear.

May 27. The appetite is good. Patient is excited at times and sleeps a good deal.

June 12. The general condition is unchanged. The appetite is good.

June 25. For the last few days patient has shown very marked nervous symptoms. There is general tremor of body. He is practically moribund. The glands in the left posterior triangle of neck punctured; the juice examined microscopically shows diplococci. Culture in broth also shows diplococci.

The following chart shows the course of the disease :—



The following table shows the result of enumeration of the blood corpuscles, the percentage of hæmoglobin and the presence or absence of diplococci and trypanosomes in the blood, lymphatic glands and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
May 25	4,400,000	13,700	28	19	19	34	80	–	+	–	–	–	–	+
June 19	5,000,000	13,700	33	35	10	22	85	–	+	–	–	–	...	...
„ 25	4,200,000	15,800	76	19	4	1	68	+	+	–	–	–	–	+
„ 26	...	...	...	...	...	...	...	+	+	...	...	...	+	...

June 26. Patient died at 12 noon. Post-mortem.

The body is not markedly emaciated. Jiggers in both feet. The pupils are equal and normal.

There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

On removing the calvarium and reflecting the dura mater some flattening of the convolutions is noticed. The sub-arachnoid fluid is increased and the pia arachnoid has the usual ground glass appearance. The superficial vessels are injected. The spinal cord to the naked eye presents nothing noteworthy. Portions of brain, spinal cord, nerve roots, ganglion, nerves and lymphatic glands of neck removed for minute investigation. A culture from the cerebro-spinal fluid shows the presence of a diplococcus.

Heart.—The cavities of both ventricles are dilated. The muscle is pale and flabby. A culture from the blood of this organ shows the presence of diplococci.

Lungs.—The right is very adherent throughout. The left nothing noteworthy.

Liver.—Shows a condition of chronic venous congestion.

Spleen.—Somewhat enlarged and shows chronic venous congestion.

Kidneys.—Both show chronic venous congestion.

Lymphatic glands.—All the groups are markedly enlarged. The femoral group shows points of suppuration. A culture from glands in the left cervical region shows the presence of a diplococcus. Smear preparations of juice show the presence of diplococci and broken down trypanosomes.

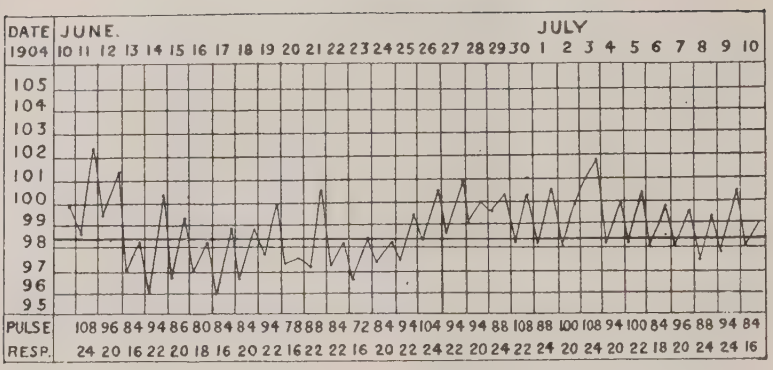
Remarks.—This case is of interest as showing that there was an invasion of the tissues by a diplococcus the day previous to death. The earlier investigation of the glands on June 19, did not show the presence of a diplococcus. Here we have a trypanosome infection with the production of all the signs of the disease. At a later period, practically in the death agony, an invasion of diplococci.

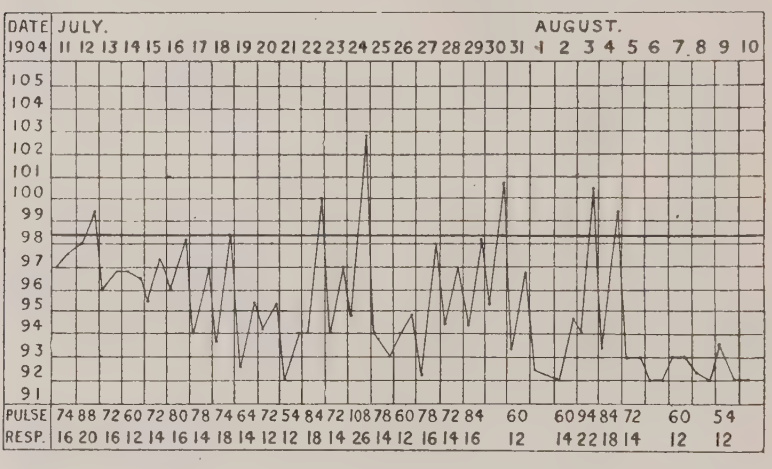
Case 69 Z.K. Msubika (Female). Age 7 years.

June 10, 1904. Patient lives on the shore of Lake near Entebbe. She states that she has been ill for one year. She has been sleeping a great deal and complains of pain in the head. She presents a dull facial expression. Choreiform movements of the hands are present. The lymphatic glands are enlarged in the femoral region and groins, slightly in the axillæ and very slightly in the posterior triangles of neck.

August 10. The patient is now in an advanced stage of the disease and is completely bedridden. General tremors of the body are present. Emaciation is not very marked. The spleen was punctured, cultures made in broth, and also smears, which showed under the microscope no fully-formed trypanosomes. The culture remained sterile.

The following chart shows the course of the disease :—





The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of diplococci and trypanosomes in the blood and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
June 10	4,350,000	12,800	33	46	13	8	84	...	...	–	–	–		+
„ 22	4,700,000	8,100	25	55	8	12	90	...	...	–	–	–	...	...
Aug. 10	5,000,000	13,700	87	10	2	1	90	...	...	+	–	–	...	...
„ 12	...	...	...	...	...	...	...	+	+	...	...	...	+	...

August 12. Patient died. Post-mortem.

The body is not markedly emaciated. No bedsores. Jiggers in both feet and hands. The superficial glands are generally enlarged.

No increase of fluid in the pleural, pericardial or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater, the surface of the brain presents the usual appearance of a sleeping sickness case. The subarachnoid fluid is increased, giving a ground glass appearance to the membrane.

The superficial vessels are injected. Portions of the brain and spinal cord removed for minute examination. A culture in broth was made from the cerebro-spinal fluid. A pure culture of diplo-streptococci was obtained.

Heart.—Normal. A culture in broth was made. A pure culture of diplo-streptococci was obtained.

Lungs.—Right is adherent throughout and the lung substance is pale and airless. Left is healthy.

Liver.—Is healthy.

Spleen.—Slightly enlarged, on section it is pigmented.

Kidneys.—Both show lobulation, otherwise nothing noteworthy.

Lymphatic glands.—In groin and femoral region are enlarged. The deep cervical are also enlarged, one in the left subaxillary region showed small points of suppuration. A culture on agar from the gland showed the presence of a diplococcus.

Bone marrow.—Removed from upper end of left humerus. No noteworthy alteration.

Remarks.—This case again shows that the tissues towards to the close of life were invaded by pyogenic cocci.

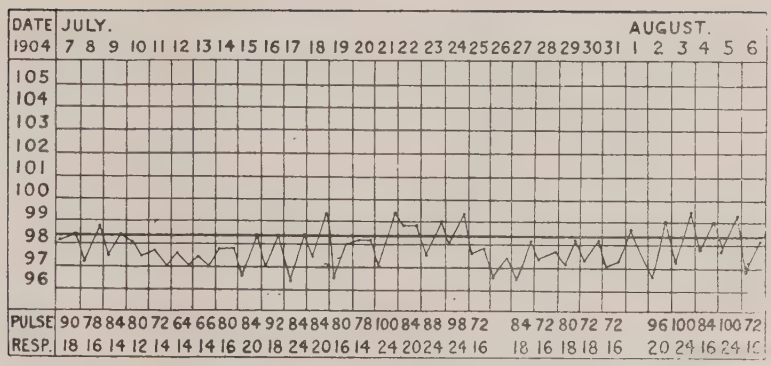
Case 69 Suedi (Male). Age 35 years.

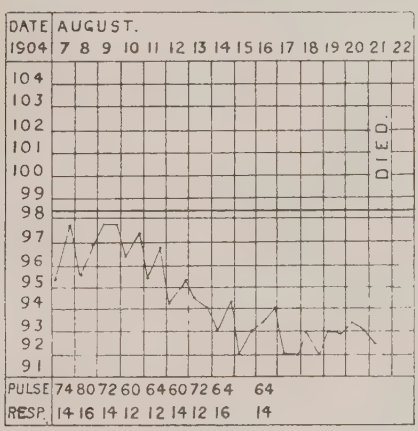
Z.M.

July 6, 1904. Patient states that he has been sick for 3 months. He suffered from pains all over his body. He now shows a general enlargement of the superficial lymphatic glands. He has now no pains. There are no tremors of tongue or hand. Pulse 134, tension fair. He appears to be in an early stage of the disease. A gland in the left posterior triangle of neck was punctured, active trypanosomes were present, but no streptococci in the juice.

August 18. He has been getting gradually worse and is now unable to walk at all.

The following chart shows the course of the disease:—





The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, and the presence or absence of streptococci and trypanosomes in the glands, blood and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
July 6	4,000,000	7,500	41	44	8	7	70	–	+	–	–	–	–	+
Aug. 3	4,150,000	9,060	55	25	9	11	80	...	...	...	...	...	...	...
„ 22	...	...	...	...	...	...	...	+	...	...	...	...	+	...

August 22, 1904. Patient died this morning at 4 a.m. Post-mortem.

There are jiggers in both feet. The body is not emaciated. Pupils equal and normal.

There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—There is some congestion of the superficial vessels. There is not much increase of sub-arachnoid fluid. The ventricles are not dilated. Spinal cord shows some post-mortem staining of the membranes, otherwise nothing noteworthy. Portions removed for minute examination. A culture on agar was made from the cerebro-spinal fluid.

Heart.—The muscle substance is fairly firm. Both posterior cusps of the aortic valve show a condition of endocarditis; on the right there is a fairly recent vegetation, the left being shrunken, the pulmonary is normal, the tricuspid and mitral valves show nothing noteworthy. A culture on agar was made from the blood of this organ.

Lungs.—Both healthy.

Liver.—Presents a peculiar condition. The right lobe is apparently normal, but to the left of falciform ligament the liver tissue stops abruptly, there being thus no left lobe. The organ is preserved for further investigation.

Spleen.—Slightly enlarged, rather soft, friable on section. On microscopic examination the pulp was seen to contain many diplo-streptococci.

Lymphatic glands.—There is general enlargement of both superficial and deep glands. The deep cervical shows points of suppuration, the pus on microscopic examination contains diplo-streptococci. A culture on agar was made from juice.

Remarks.—In this case there was a general invasion by a diplo-streptococcus before death. There was also a recent endocarditis, probably associated with the general infection. The invasion must have occurred at a stage when the resisting power of the patient was very low and helped the fatal termination.

Case 69 Zimageza (Male). Age 14 years.
Z.N.

July 11, 1904. Patient was admitted into the hospital on July 4. He lives at Bugabu, near Entebbe, on the shore of the lake. He states he has been ill for six months. He complains of pains all over his body. He now presents all the usual signs of a case of sleeping sickness in the late second stage of the disease. The facial expression is very dull. The voice is weak and monotonous. Tremors of hands and tongue are present. The superficial glands are generally enlarged. The spleen is slightly enlarged. Liver is not enlarged. The heart sounds are weak, no brûit. Pulse 100, tension is low. A gland in the left posterior triangle of neck was punctured; active trypanosomes were present, no streptococci.

July 19. The patient is rapidly deteriorating in his general

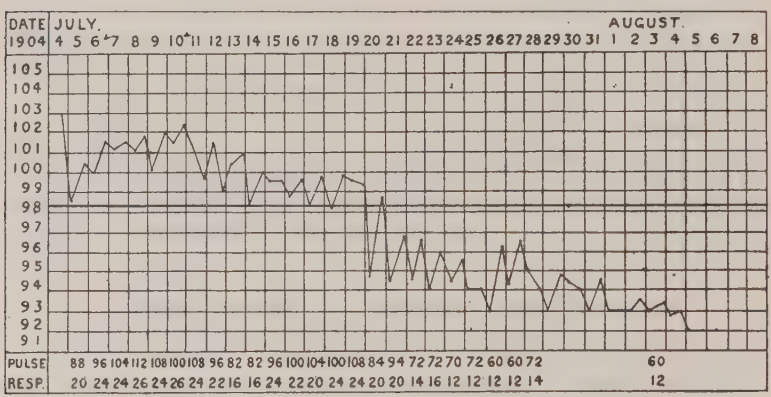
condition and is now practically bedridden being, in the last stage of the disease. A gland in the left posterior triangle was punctured, many active trypanosomes were present. The blood examined by films showed also many trypanosomes. Arsenious acid, 15 milligrammes, was injected into muscle of left gluteal region.

July 20. The glands in left posterior triangle of neck were punctured, no active trypanosomes were present. Examination of the blood by films also showed the absence of trypanosomes. No streptococci in the glands.

July 29. The examination of the blood of this patient showed that there was a marked increase in the number of the red corpuscles and the percentage of hæmoglobin. The specific gravity was 1068. 1·5 litres of 0·75 per cent. sodium chloride solution were injected subcutaneously into both axillæ at 12 noon. The examination of the blood at 3 p.m. on the same day showed that the number of red cells had fallen from 6,400,000 to 5,400,000, and the percentage of hæmoglobin from 100 per cent. to 83 per cent., and the specific gravity from 1,068 to 1,065.

August 5. The patient is now practically moribund. The spleen was punctured. Examination of the blood from the spleen showed no active trypanosomes, but a number of diplococci were present, also a few nucleated red corpuscles.

The following chart shows the course of the disease :—



The following table shows the result of the enumeration of the blood cells, the percentage of hæmoglobin and the presence or absence of trypanosomes and diplococci in the lymphatic glands, blood and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
July 11	5,000,000	10,900	52	28	18	2	88	−	+	−	−	+	−	+
„ 19, 10 a.m. ...	5,000,000	11,800	40	46	13	1	90	−	+	−	−	+	...	...
„ 19, 4 p.m. ...	...	...	54	40	6	...	...	...	...	...	...	+	...	...
„ 20	...	...	...	...	...	...	...	−	−	...	...	...	...	...
„ 21	5,200,000	8,120	30	51	8	11	92	−	...	...	...	−	...	...
„ 23	...	...	...	...	...	...	...	...	−	...	...	−	...	...
„ 26	...	...	...	...	...	...	...	...	...	...	...	−	...	...
„ 27	...	...	...	...	...	...	...	...	...	...	...	−	...	...
„ 29	6,400,000	8,700	...	...	...	...	100	...	...	...	...	...	...	...
„ 29	5,400,000	...	...	...	...	...	83	...	...	...	...	...	...	...
Aug. 5	...	...	...	...	...	...	...	+	...	...	...	...	...	...
„ 7	...	...	...	...	...	...	...	+	...	...	...	...	+	...

August 7, 1904. Patient died in the night. Post-mortem.

The body is distinctly emaciated. Jiggers in both feet. There are no bed-sores. There is general enlargement of superficial lymphatic glands.

There is no increase of fluid in the pleural, pericardial or peritoneal cavities.

Brain.—There is some increase of sub-arachnoid fluid, giving the usual ground glass appearance to the membranes. The superficial vessels are injected. There is no flattening of the convolutions. The ventricles are dilated. The spinal cord shows no noteworthy change. Portions of brain, spinal cord, nerves with ganglion and roots removed for minute investigation. A culture in broth of the cerebro-spinal fluid shows the presence of a diplococcus.

Heart.—Cavities are dilated, the muscle wall is pale and flabby, otherwise nothing noteworthy. A considerable number of nucleated red blood corpuscles are present in the blood of this organ. A culture in broth of the heart's blood shows the presence of a diplococcus.

Lungs.—Left shows some hypostatic congestion towards its posterior aspect and small areas of collapse. The right lung is healthy.

Liver.—Shows a condition of advanced chronic venous congestion.

Spleen.—Is enlarged and congested, a film from this organ shows the presence of a diplococcus.

Kidneys.—Both show early stage of chronic venous congestion.

Intestines.—Normal.

Lymphatic glands.—All the groups are distinctly enlarged and markedly congested. Films made from the glands show the presence of a diplococcus. A culture in broth from a cervical gland gave a pure culture of diplo-streptococci.

Bone Marrow.—The marrow was removed from the upper end of the right humerus. It presented a somewhat deeper red colour than normal. Film preparations were made and stained. These showed a remarkable increase in the number of nucleated red corpuscles, many were of the normoblastic type, but some, also, were apparently megaloblastic.

Remarks.—This case is of considerable interest and importance. One of the most striking features in it was the remarkable blood picture presented. During life the number of the red cells, the percentage of hæmoglobin and the specific gravity were higher than normal. The blood during life showed nucleated red corpuscles. After death the examination of the bone marrow showed a very large number of nucleated red cells. The changes in the blood took place shortly before death. In this case there was a general invasion by a diplococcus just before death. To what extent this was responsible for the peculiar condition of blood and bone marrow it is difficult to say. At one time this patient had a very large number of trypanosomes in the peripheral blood. The effect of injection of

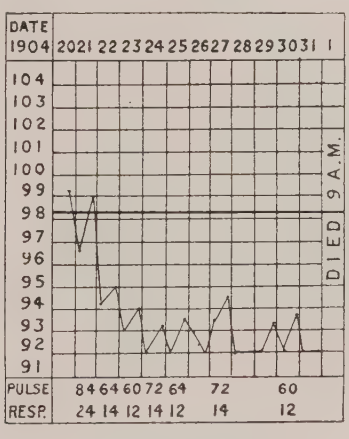
a considerable quantity of salt solution in diminishing the number of red cells, percentage of hæmoglobin and specific gravity (which were all higher than normal) was interesting. The result of the injection of the sodium arsenite was also interesting.

CASE 69 Z.Q. GEERUDE (MALE). AGE 25 YEARS.

August 20, 1904. Patient, who is a Waganda, was sent in from Kakumiro. He complains of pains in his body, and has been sick for some time. He is now very drowsy, and his speech is slow and monotonous. Facial expression is dull. Slight tremors of tongue and hand present. The heart sounds are normal. Pulse 85, tension is fair. Lungs normal. The knee jerks are present and normal. A gland in the right posterior triangle of neck was punctured, and the juice was found to contain active trypanosomes, but no diplococci. The cerebro-spinal fluid also contained active trypanosomes.

August 30. The patient has been passing black motions for about two to three days. No vomiting.

The following chart shows the course of the disease:—



The following chart shows the presence or absence of trypanosomes or diplococci in the lymphatic glands and cerebro-spinal fluid:—

Date.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
	Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.							
Aug. 20	−	+	−	−	+	−	+
Sept. 1	−	...	...	...	...	−	...

September 1. Patient died. Post-mortem.

The body is not emaciated. There is general enlargement of the superficial lymphatic glands.

No increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—Shows some congestion of the superficial vessels and increase of sub-arachnoid fluid. The ventricles are dilated. A culture in broth made from the cerebro-spinal fluid remained sterile.

Heart.—Nothing noteworthy. A culture in broth made from the heart blood remained sterile.

Lungs.—Both healthy.

Liver.—Nothing noteworthy.

Spleen.—Slightly enlarged.

Kidneys.—Nothing noteworthy.

Pancreas.—Is somewhat enlarged and congested.

Stomach.—On opening this organ it is found to contain a considerable quantity of altered blood. The mucous membrane is seen to be studded with a large number of areas which have a dark centre and a periphery of lighter red in the centre, the mucous membrane is eroded. These areas vary in size, are circular in shape. Scrapings from these ulcers did not show the presence of ova of Bilharzia. *Vide* Plate.

Intestines.—Are normal.

Remarks.—This case is given on account of the curious condition met with, post-mortem, in the stomach; since attention has been directed to this point the stomach of four cases of sleeping sickness have been examined, and a very similar condition found in each. These areas, on microscopic examination are seen to be small hæmorrhages into the mucous membranes, and these become broken down under the action of the gastric juice giving rise to the superficial ulcers.

EXPERIMENT 69 Z.R. ZAKAYO (MALE). AGE 20 YEARS.

August 31, 1904. This patient was admitted into hospital about six months ago. He ran away. He was picked up a few days ago on the road and brought to hospital. He is now in a very advanced stage of the disease. There is considerable emaciation. There is general enlargement of the superficial lymphatic glands. The facial expression is very dull. Tremors of tongue and hands are present. The heart sounds are weak. Pulse 72, tension is low.

Lungs.—No physical signs of disease.

Liver and Spleen.—Are not palpable.

A gland in the left posterior triangle of neck was punctured and active trypanosomes were found in the juice. No streptococci were seen.

September 4. The patient is in a moribund condition.

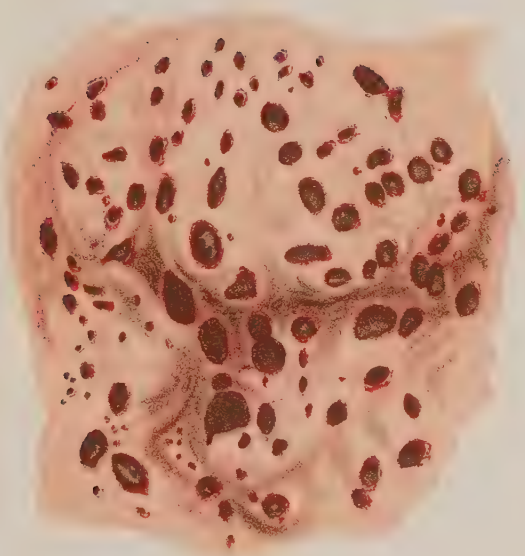
The following chart represents the course of the disease:—

PORTION OF STOMACH

OF

GEERUDE, CASE OF SLEEPING SICKNESS,

SHOWING ULCERATION OF MUCOUS MEMBRANE.



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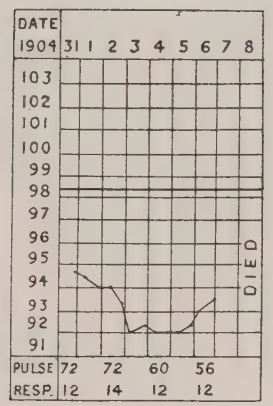


The following table shows the result of the enumeration of the blood corpuscles, the percentage of hæmoglobin, and the presence or absence of trypanosomes and diplo-streptococci in the glands, blood, and cerebro-spinal fluid :—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil	Mal.	Tryp.	Strept.	Tryp.
1904.														
Aug. 31	...	...	...	...	...	...	...	−	+	...	...	...	−	+
Sept. 1	5,000,000	13,100	60	22	12	6	74	...	...	−	−	−	...	...
„ 8	...	...	...	...	...	...	...	−	...	...	...	...	−	...

September 8, 1904. The patient died. Post-mortem.

The body is somewhat emaciated. There is general enlargement of the superficial lymphatic glands. The pupils are equal and normal. There is no increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—There is some increase of sub-arachnoid fluid. The membranes have the usual ground glass appearance. The superficial vessels are injected. Spinal cord shows no noteworthy change to the naked eye. A culture in broth from cerebro-spinal fluid examined sterile.

Heart.—Apparently healthy. A culture in broth from heart blood remained sterile.

Lungs.—Both healthy.

Liver.—Not enlarged, has somewhat mottled appearance on section.

Spleen.—Slightly enlarged. Some old perisplenitis.

Kidneys.—Nothing noteworthy.

Stomach.—On opening this organ, the mucous membrane presents a remarkable appearance, there are numerous small petechial areas studded all over its surface, towards the pyloric end they are larger and more numerous. Each area has a dark centre surrounded by a light red zone. They vary in size from about a pin point up to $\frac{1}{8}$th of an inch in diameter. No ova of Bilharzia were seen in the scrapings.

Intestines.—Show nothing noteworthy.

Lymphatic glands.—There is general enlargement of the lymphatic glands. A culture in broth made from the left cervical gland remained sterile.

Remarks.—This case is of considerable interest, owing to the curious condition found, post-mortem, of the mucous membrane of the stomach. This is the fourth case in which the stomach has shown this change in sleeping sickness. It would therefore appear that this morbid condition is in some way bound up with the pathology of the disease.

CASE. KASEMOTE (MALE). AGE 35 YEARS. WANYAMWESI.

August 12, 1904. Patient was sent up for examination. Lymphatic gland in left posterior triangle was punctured and the juice found to contain active trypanosomes. He refused to remain in hospital.

October 1. Patient was admitted to hospital to-day. He is distinctly ill. Superficial lymphatic glands are enlarged generally. Complains of vomiting, especially after food. His voice is low and monotonous, speech is very indistinct. Facial expression is dull. Tongue is tremulous. Heart sounds are normal. Cerebro-spinal fluid contains many active trypanosomes. They were found without centrifuging.

October 10. General condition of patient is much worse, and he is completely bedridden.

October 17. Patient died.

October 18. Post-mortem. The body is emaciated. No

bedsores, general enlargement of superficial lymphatic glands. Port-mortem, decomposition advanced. No increase of fluid in the pericardial, pleural or peritoneal cavities.

Heart and Lungs.—Both normal.

Spleen.—Very slightly enlarged.

Liver.—Healthy.

Stomach.—Towards the pyloric orifice several small petechial hæmorrhages are present. Also several larger areas of congestion. The appearance is very similar to that found in several other cases of sleeping sickness.

Intestines.—Normal. No ova of Bilharzia found in the stomach or intestines.

Remarks.—This case is given, as it is another example of this curious condition of stomach which has been met with amongst the cases of sleeping sickness here.

Case. Sebugwao (Male). Age 19 years.

September 27, 1904. Patient lives in the Swahili lines, Entebbe. He has been sick for two months. He complains of pain in the head. The facial expression is dull and heavy. General enlargement of the superficial glands. Spleen is enlarged. Liver is not enlarged. Heart sounds are normal. Lungs, nothing noteworthy. Gland in the left posterior triangle of neck was punctured, a culture in broth was made from the juice, this remained sterile. The juice contained many active trypanosomes. The cerebro-spinal fluid contained active trypanosomes.

October 31. Patient died.

November 1. Post-mortem.

The organs generally present the usual appearances met with in cases of sleeping sickness. The stomach, however, presents a curious condition. The mucous membrane is studded with petechial areas, and the stomach also contains a quantity of dark material. The condition is very similar to that observed in the other cases of sleeping sickness.

Remarks.—This case is given to again direct attention to the frequency of this peculiar condition of the mucous membrane of the stomach.

Case 69. Zururu bin Mza. Age 25 years.

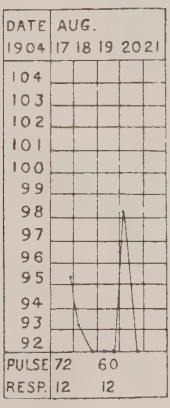
Sailor on Government boat, Lake Albert. Swahili.

August 17, 1904. Admitted to hospital to-day. Captain Hutchinson writes, "That this man was one day in Entebbe before proceeding to Lake Albert, where he remained two years." He was ill for two months on Lake Albert, suffering from pains in the body. He has a very dull, drowsy expression of the face. There is general enlargement of the lymphatic glands, very marked in the anterior and posterior triangles of the neck. Tremors of tongue and hands present. Knee jerks

are normal. Spleen and liver not enlarged. Heart, no brûit heard. His voice is very low and monotonous. He is expectorating rusty sputum. A gland in posterior triangle of neck was punctured, many active trypanosomes present in the juice.

August 18. Lumbar puncture performed. Trypanosomes present without centrifuging. A culture in broth and agar of juice from gland in left posterior triangle remains sterile.

The following chart shows the course of the disease:—



The following table shows the result of enumeration of the blood corpuscles, the percentage of hæmoglobin, the presence or absence of diplo-streptococci and trypanosomes in the blood, lymphatic glands, and cerebro-spinal fluid:—

Date.	R.B.C.	W.B.C.	Percentages.				Hb. per cent.	Parasites in glands.		Parasites in blood.			Parasites in C.S.F.	
			P.N.	S.M.	L.M.	E.		Strept.	Tryp.	Fil.	Mal.	Tryp.	Strept.	Tryp.
1904.														
August 17	...	...	...	...	...	...	...	−	+	...	...	...	...	...
„ 18	4,900,000	3,800	60	22	12	6	66	...	+	...	...	...	...	+
„ 21	...	...	...	...	...	...	...	−	...	...	...	...	−	...

August 21. Patient died. Post-mortem.

The body is fairly well nourished. There is general enlargement of superficial lymphatic glands. No sores. The pupils are equal and normal.

No increase of fluid in the pericardial, pleural or peritoneal cavities.

Brain.—On removing the calvarium and reflecting the dura mater the convolutions are seen to be congested with some flattening. The sub-arachnoid fluid is increased. The spinal cord shows nothing noteworthy to the naked eye. Portions of nervous system removed for minute examination.

Heart.—Muscle substance is pale and flabby, cavities are all dilated.

Lungs.—Left, towards the base there is a patch of pneumonic consolidation in a state of red hepatisation, it involves about half the lower lobe of the lung. There are some flakes of recent pleurisy over this area, rest of lung healthy. Right, nothing noteworthy.

Spleen.—Slightly enlarged.

Liver.—Deeply congested.

Kidneys.—Nothing noteworthy.

Glands.—The various groups show enlargement.

Remarks.—This case is of great importance as indicating that the fly belt on Lake Albert has become infected.

12.

REPORT ON SLEEPING SICKNESS IN THE NILE VALLEY.

BY

CAPTAIN E. D. W. GREIG, I.M.S.

In the Introduction to the Report 9 it was mentioned that Captain Greig left Entebbe for England *viâ* the Nile; this Report contains the record of his observations on the distribution of sleeping sickness and tsetse fly in the Nile Valley.

About a year ago the exact distribution of *Glossina palpalis* was marked out on Lake Albert for the Commission by Mr. W. Y. Wyndham, then Collector, Wadelai. At that time no report of the presence of sleeping sickness in that district had been received. That the "belt" had become infected was suggested, in the first instance, by a case of sleeping sickness (Case 69, Zururu bin Mza) which was admitted into Entebbe Hospital from Lake Albert on August 17, 1904. This case is recorded in Appendix. Later a report was received by H.M. Acting Commissioner, Mr. George Wilson, C.B., from Mr. T. Grant, Collector, Hoima, stating that a

disease resembling sleeping sickness had broken out amongst the inhabitants of Bugungu on the north-eastern shores of Lake Albert. It was therefore of great importance to determine (1) if the disease in Bugungu was sleeping sickness; (2) how far north the disease extended; and (3) the distribution of *G. palpalis* along the Nile banks.

The co-operation of the Government of Egypt having been obtained, it was possible to make observations from Lake Albert down the Nile to Khartoum under specially favourable conditions.

I left Entebbe on November 15, 1904, and proceeded direct to Hoima, arriving there on November 25, 1904. Halting there till December 6, the cases of suspected sleeping sickness from Bugungu, collected there for me by Dr. Pooley, Medical Officer, Hoima, were all carefully examined. From Hoima the march was continued to Butiaba on Lake Albert. From there I proceeded to Bugungu by sailing boat "James Martin." At this point I was met by the Government steam launch and proceeded towards the Victoria Nile, examining on the upward journey the south bank as far as the Murchison Falls and the north bank on the return journey. This occupied four days. Proceeding down the Nile, Wadelai was reached on December 11. Halting here two days some of the general population were examined for trypanosoma infection, and the villages for actual cases of sickness. From Wadelai the journey was continued down the Nile to Nimuli. Halting here for four days, an investigation of a number of the general population for trypanosoma infection was made. From Nimuli the march was continued along the right bank of the Nile to Gondokoro. This was reached on December 27, 1904. At Gondokoro I was joined, on December 30, by Dr. Sheffield Neave, sent by the Egyptian Government to co-operate with me. The gunboat "Abu Klea" was placed at our disposal to investigate the banks of the Nile as far as Bor. From here the journey was continued through the sudd in the post-boat "Amka." Khartoum was reached on January 21, 1905. This completed the investigation.

As it is of extreme importance to ascertain whether *G. palpalis* is present or absent, not only on the banks of the Nile but throughout the whole Sudan; an arrangement was made by which each official of the Sudan Government stationed in the various districts will receive a specimen of the *G. palpalis*, with a memorandum requesting information as to the presence or absence of this fly or flies resembling it (collections to be sent for identification to headquarters), and as to the character of the country, etc., should the fly or one resembling it be found. The results of the investigation on the banks of the Nile are recorded on the two maps which accompany this report, *see* p. 102. The red dots represent the distribution of the *G. palpalis* on the one map and of sleeping sickness on the other. It may be briefly stated that the following facts were ascertained:—

1. The disease on Lake Albert from which the people were dying was undoubtedly sleeping sickness.
2. The disease could be traced, in diminishing severity, along the south and north banks of the Victoria Nile, below the Murchison Falls, and as far north as Wadelai.
3. Examination of the lymphatic glands of the general population of Nimuli showed that the proportion of enlarged cervical glands was low, and the examination of the juice of these glands was negative as regards trypanosomes. No case of sleeping sickness has been recorded here.
4. The distribution of *G. palpalis* coincides with the area of sleeping sickness. It terminates on the Nile banks a little north of the point where the 4th degree cuts the Nile. Here the character of the country begins to alter, open spaces and sparse vegetation giving place to undergrowth and trees.
5. *G. palpalis* was not found on the banks of the Nile in the Sudan.
6. *G. morsitans* has been found in the Bahr-el-Ghazal province. This interesting observation was made by Colonel Griffith, D.S.O., P.V.O., who states "that he found *G. morsitans* in the Bahr-el-Ghazal province on the banks of the Pongo River, where the road to Deim Zubeir crosses it."

1. *Sleeping Sickness is present in the "Fly belt" at Bugungu, Lake Albert.*

Eighteen cases were collected at Hoima by Dr. Pooley from Mwanga's shamba, Bugungu.

These were, clinically, typical cases of sleeping sickness at different stages of the disease. Trypanosomes were found in the gland fluid of every case. The cerebro-spinal fluid was examined in several cases and the trypanosomes found in every case. Dr. Pooley reported on December 13, "that six of the above cases had since died."

It is interesting to note that a blood-sucking maggot is found in Unyoro. Specimens were brought in to Dr. Pooley by the natives. Specimens of the maggot have been sent to Mr. Austen for identification. A curious feature was, that the dogs in the sleeping sickness area died in considerable numbers of a wasting disease. Two sick dogs were sent to Entebbe to be kept under observation. Lieutenant Gray, R.A.M.C., writes on January 19, 1905, "that one of the dogs shows trypanosomes. Of the two monkeys and the guinea-pig which we infected from this dog, (*a*) the guinea-pig has not yet shown trypanosomes; (*b*) monkey showed trypanosomes eleven days after infection; (*c*) second monkey has not yet shown trypanosomes." It will remain to be seen from further observation to what variety of trypanosoma this belongs.

2. *Sleeping Sickness is present in the "Fly belt" as far north as Wadelai.*

At various villages on the south and north banks of the Victoria Nile and the right bank of the Nile to Wadelai the general population were examined and the chiefs questioned regarding the occurrence of sleeping sickness. The method of investigation was by examination of the lymphatic glands as recorded in the Report, page 275.

The following table shows the village or station examined, and the presence or absence of sleeping sickness in the general population:—

Name of village or station.	Situation.	Sleeping sickness.	Number of cases.
Borigi ...	South bank, Victoria Nile, 15 miles from mouth.	Present ...	Two early cases.
Fajao ...	Near Murchison Falls.	„ ...	One case reported.
Kimori ...	North bank of Victoria Nile, 7 miles from mouth.	„ ...	Sixteen men examined. Thirteen had enlarged cervical glands with rapid pulse. Chief reports eight persons died in his village last month of sleeping sickness.
Wadelai ...	Right bank Nile...	„ ...	Fifteen of the general population examined. Four had enlarged cervical glands. Trypanosomes found in one. One case of undoubted sleeping sickness.

3. *Sleeping Sickness at the present time does not occur as far north as Nimuli.*

At this station the cervical glands of eighty-seven males of the general population were examined, namely, sixty Nubian Askaris and twenty-seven Askaris from Afuddu. A few of these showed slight enlargement of the cervical glands, but microscopic examination of the juice was negative as regards trypanosomes.

Through the courtesy of Commandant H. V. Calseyde, I was enabled to examine a number of the general population of Dufile in the Enclave. One case of trypanosoma infection was found. This was imported from the interior. This observation

is of considerable importance as indicating a route along which the infection might enter the "Fly belt" of the Nile.

No cases of sleeping sickness have occurred at Gondokoro or in the Sudan.

4. Glossina palpalis *extends along the banks of the Nile* 30 *to* 50 *miles north of the point where the* 4*th degree cuts the Nile.*

The red dots on the map indicate the position where the *G. palpalis* was actually found; at some points it was extremely numerous; this was especially so at Fajao, on both sides of the Nile at the Falls. *G. palpalis* is found all along the banks of the Nile in Uganda territory. It only ceases to occur a short distance south of Gondokoro. It is interesting to note that, at the point where the fly ceases, the character of the country alters completely. It becomes more open, the undergrowth is not found, and the trees are further apart, and therefore affording much less shelter from the sun.

5. Glossina palpalis *was not found on the banks of the Nile between Gondokoro and Khartoum in the Sudan.*

I examined both banks of the Nile at each possible landing place as far as Bor, but with negative results. From Bor the journey was continued through the sudd. No specimen of *G. palpalis* was found, nor at any point on the journey to Khartoum. Dr. Sheffield Neave will continue and extend the observations on these lines in the Sudan under the direction of Dr. A. Balfour.

6. Glossina morsitans *occurs in the Bahr-el-Ghazal province of the Sudan.*

The observation of Colonel Griffith shows that the *G. morsitans* exists on the banks of the Pongo River.* Mr. Brown, of the Imperial Institute, who has recently been in the Bahr-el-Ghazal, considers "that the Fly is more numerous on the west bank. There is a forest of trees on the west bank. The trees are more scattered on the east." He also states "that the Fly occurs on the Jur River near Wau." It is of great importance that this belt should be accurately defined. Dr. A. Balfour, Director of the Gordon College Laboratory, Khartoum, has found trypanosomes in the blood of animals from the Bahr-el-Ghazal.

7. *Has the Nile "Fly belt" become infected from Uganda or the Congo?*

It is obvious that the infection must have been carried in from one or other of these areas of sleeping sickness. Its

* *Vide* Map of Africa showing distribution of Tsetse flies by Mr. Austen p. 282.

greater severity in Unyoro and gradual diminution north appears to suggest that it gained an entrance from the Uganda side, but cases are found in close proximity on the left bank of the Nile. It is impossible therefore to definitely answer the question.

The general situation as regards sleeping sickness in the Nile Valley is, that sleeping sickness is slowly spreading in the "Fly belt" and will extend to its northern and southern limit. As the northern limit does not extend into the Sudan, there will not be a direct extension of the disease along the Nile into this country. As, however, a closely related species (*Glossina morsitans*) exists in the Bahr-el-Ghazal province, it will be of the utmost importance to prevent the introduction of people from sleeping sickness areas into this "belt," and to accurately define the limits of the "belt."

I desire to express my most sincere thanks to H.E. Lord Cromer, for enabling me to undertake the investigation in the Sudan: to Sir Reginald Wingate, Sirdar and Governor-General of the Sudan, for facilitating my work in every way, to Colonel Griffith, D.S.O., P.V.O., and Dr. A. Balfour, for information received, and to other officials in the Sudan and Egypt, who helped me in the work, for their constant and generous co-operation. To Mr. George Wilson, C.B., H.M. Acting Commissioner, Uganda, for giving facilities for the work in Uganda; Dr. R. U. Moffat, C.M.G., for help and advice; Mr. T. Grant, Collector, and Dr. G. H. Pooley, M.O., Hoima; Mr. P. W. Cooper, Collector, and Dr. G. C. Strathairn, M.O., Wadelai; Mr. Guy Eden, Collector, and Dr. Ralph Stoney, M.O., Nimuli; Mr. F. Spire, and Dr. C. J. Baker, M.O., Gondokoro, for help and co-operation whilst on tour in Uganda.

13.

THE DISTRIBUTION OF THE TSETSE-FLIES.

(Genus *Glossina*, Wiedemann, as at present known.)

WITH MAP.

By E. E. Austen, F.Z.S.

(Author of *A Monograph of the Tsetse-flies*, etc., etc.)

Although our knowledge of the distribution of the eight species of tsetse-flies is still very far from complete, it is nevertheless possible, owing in large measure to the special attention that has been paid to the genus *Glossina* within the last two years, to make an attempt to illustrate the distribution of the various species by means of a map. In view of the possibility that the trypanosome of sleeping sickness may be conveyed by other species of *Glossina* besides *Gl. palpalis*, it is

the more important that this should be done, especially since no such attempt has hitherto been made. The map published in the writer's Monograph of the Tsetse-flies (1903) merely showed what was then known of the distribution of the genus as a whole, without attempting to discriminate between the species; and although a map showing the distribution of the different species was exhibited by the author at Oxford in July, 1904, in connection with a paper on tsetse-flies* read by him in the section of Tropical Diseases, at the Annual Meeting of the British Medical Association, it was unfortunately not found possible to reproduce the map when the paper was printed. The accompanying map, in the preparation of which the writer has been most kindly assisted by Mr. A. J. Engel Terzi, will, it is hoped, at least serve as a basis for future work.

Since it may now be assumed to be well understood that tsetse-flies are not met with continuously throughout broad tracts of country, but are confined to relatively narrow "belts," which are frequently discontinuous, and are usually to be found along the margins of water-courses, rivers, and lakes, it is perhaps hardly necessary to explain that a particular species must not be supposed to occur everywhere within the areas marked on the map. The latter only shows broadly what is at present known of the *relative distribution* of the different species, which, in view of the scale used, was all that was possible. Similarly, where a species of tsetse is shown as occurring along a river or on the margin of a lake, the map must not be taken as giving any indication whatever of the distance from the water to which the fly is to be found, which in some cases may be merely a few yards.† Moreover, the fact that any particular locality lies within the limits of the occurrence of a species of tsetse, as shown on the map, is not to be taken as implying that the fly necessarily exists there to-day. The areas marked are in accordance with records or the localities of actual specimens, but in some instances, as has certainly happened in the case of *Gl. morsitans* in parts of the Zambesi Valley, owing to the retreat of big game or other causes, tsetse-flies are no longer to be found in places formerly infested by them. When isolated areas are marked as the home of one or more species, it is to be understood that specimens have been received from these localities, or else that there are apparently reliable records of the occurrence there of the species concerned; in many cases more complete collections or fuller information would doubtless prove their existence in intervening localities also.

With these introductory remarks the map may be left to explain itself, but the following notes on certain of the species of *Glossina* will perhaps be of interest.

Glossina palpalis. Rob.-Desv.—This species has recently

* "Supplementary Notes on the Tsetse-flies (Genus *Glossina*, Wiedemann)," by Ernest E. Austen, *British Medical Journal*, Sept. 17th, 1904.

† For information as to "fly-belts," and their extent, and the distribution and limits of Tsetse within these areas, *cf.* "Monograph of the Tsetse-flies," p. 9, *et seq.*

been reported by Laveran* as occurring at Sengaleam, in Senegal, about six miles from Rufisque, and thirty from Cape Verde; this is the most northerly locality yet recorded for any tsetse-fly. In West Africa the limit of the range of *Gl. palpalis* towards the interior is entirely unknown, so that no attention should be paid to the inner boundary of the area shown on the map. In this region most of the specimens and records of occurrences are derived from localities near the coast, and it is consequently impossible to say how far the species extends into the interior, although it may reasonably be supposed to occur throughout the valleys and basins of the majority of the rivers that fall into the Atlantic within the limits of the tropics. Since we now have records of the occurrence of *Gl. palpalis* at various points between Sengaleam and the Congo inclusive, the species is shown on the map as occurring throughout this area, for, although the evidence is not yet complete, there is no reason whatever to imagine that it will not ultimately be found to exist in all suitable localities within these limits. According to our present knowledge, therefore, the distribution of *Gl. palpalis* extends from Cape Verde in the north-west throughout West Africa to an unknown distance into the interior, and southwards to the Congo. In the equatorial region the eastern limits of the species as at present known are the River Omo, which falls into the northern end of Lake Rudolf, and the eastern shore of Lake Victoria. It was encountered by Dr. Brumpt from the sources of the Welle to the mouth of the Congo, and since Laveran† states that he has identified it among specimens from Katanga, in the south-east corner of the Congo Free State (the most southerly record at the present time), it is probably to be found throughout the Lualaba-Congo system as well. South of the Congo *Gl. palpalis* doubtless occurs throughout the greater part, if not the whole of Portuguese West Africa, since, although actual records of the occurrence of the fly are at present lacking, and no collections have as yet been made in this region, according to Dr. H. Rey,‡ Sleeping Sickness has been observed from Benguella northwards.§

Glossina morsitans, Westw.—In the paper already referred to, Dr. Laveran records the identification by him of this species among material from French Guinea, the Rivers Assinie and Comoë (Ivory Coast), and Katanga in the Congo Free State, to

* *Comptes Rendus des séances de l'Académie des Sciences*, t. cxxxix (Séance du 31 Octobre, 1904), p. 659.

† *Loc. cit.*, p. 662.

‡ Quoted by Christy, Reports of the Sleeping Sickness Commission, No. III, Nov., 1903, p. 7.

§ Since these notes and the accompanying map were prepared, the British Museum has received from Dr. F. Creighton Wellman a form of *Gl. palpalis* taken by him in November last on the Katumbela River, Benguella; the specimens are somewhat different from the typical form, and represent a new sub-species, which the author has described as *Gl. palpalis wellmani*. In the Congo Free State, according to information furnished by the Rev. W. Holman Bentley, of the Baptist Missionary Society, *Gl. palpalis* is abundant some eighty miles to the south-east of Luttete.

the south-west of Lake Mweru. Collections received at the British Museum last autumn from Mr. Robert Codrington, Administrator of North-Eastern Rhodesia, show that *Gl. morsitans* may be said to be distributed throughout North-Eastern Rhodesia.

As regards *Gl. morsitans* in the Bahr-el-Ghazal province of the Sudan, the locality shown on the map is that of the specimen obtained by Colonel Griffiths in 1903, on the Pongo River, between Wau and Dem Zibehr, where the species appears to be very abundant. Dr. Andrew Balfour, of the Gordon College Laboratories, Khartoum, in a letter to the writer dated January 9th, 1904, said that during a recent journey to Uganda a native officer informed him that the fly is found six miles inland from Shambe, on the Bahr-el-Jebel. Dr. Balfour is inclined to think that in the Egyptian Sudan *Gl. morsitans* is "limited to the Bahr-el-Ghazal province, and does not extend further north than the river of that name." Major Penton, R.A.M.C., whom the writer has lately seen, is disposed, as the result of experience gained during recent service with the Egyptian Army, to agree with Dr. Balfour, and thinks that at any rate *Glossina morsitans* is not to be found to the north of Fashoda.

Glossina tachinoides, Westw.—This species is recorded by Laveran* from the river Bani, a tributary of the Niger, in the French Sudan. The same author (*ibid.*, p. 659) also speaks of its occurrence on the Lower Rio Nunez, French Guinea; but, since this is an isolated record, it is not shown on the map.

Glossina pallidipes, Austen.—In October, 1904, specimens of this species were forwarded from Gosha, Jubaland, East Africa Protectorate, by Major L. H. R. Pope-Hennessy, 3rd King's African Rifles. Writing from Kismayu on October 11th last, Major Pope-Hennessy states that the natives say that this fly is deadly to cattle and camels, and adds that "should recruits with the germ of sleeping sickness in them be obtained from Uganda, and be bitten by this fly, the disease may be propagated in Gosha, and perhaps annihilate our only hard-working section of the inhabitants. Apart from questions of humanity, this would put an end to any opening-up of the country."

Glossina longipalpis, Wied.—A specimen of this species obtained long ago by Sir John Kirk and labelled "Zambesi" is in the British Museum collection, but since the precise locality is unknown, the species is not shown on the map as occurring in the region in question. It is recorded by Laveran† from French Guinea and Katanga, Congo Free State.

Glossina fusca, Walk., is now known from a number of widely distant localities, and its area of distribution, in addition to being in all probability co-extensive with that of *Gl. palpalis* in West Africa, also extends to Central and East Africa. Apart from previous records, the writer has recently seen a specimen

* *Loc. cit.*, p. 661.
† *Loc. cit.*, pp. 659, 662.

from Usagara, German East Africa, obtained by the Rev. A. North Wood, in 1904. A specimen in the British Museum collected by Sir John Kirk, is simply labelled "Zambesi," but the occurrence is not recorded on the map for the reason stated above in the case of *Gl. longipalpis*. As regards West Africa, the latest record is one by Laveran (*loc. cit.*) from French Guinea.

Glossina fusca was met with in July, 1904, fifteen miles north-east of Chiromo, British Central Africa, by Major F. B. Pearce, Deputy Commissioner, British Central Africa Protectorate. Writing from "The Residency, Zomba, British Central Africa," on November 8th, 1904, Major Pearce says:—"I have arranged to have a few head of cattle kept within the fly (*Glossina fusca*) zone, so as to arrive at some conclusion with regard to the question whether *Gl. fusca* is dangerous to live stock. In this connection you may perhaps be interested to know that a herd of Government cattle has been kept for years at Chiromo, and it is not an unusual occurrence for them to graze in the Elephant Marsh actually in sight of buffalo. The Chiromo cattle have always done very well, and none have ever been lost from "fly" sickness. The same may also be said concerning the cattle of the chief Makwira, who has a large number of cattle, which always graze in the "Marsh," where buffalo are common. If therefore the only species of "fly" in the Elephant Marsh game reserve is *Gl. fusca*, it would seem that that species is not dangerous to live stock." It may be noted that Major Pearce's statements as to the apparent harmlessness of *Glossina fusca* to domestic animals are supported by Stuhlmann's observations on the same species near Dar-es-Salâm.*

British Museum (Natural History),
Cromwell Road,
London, S.W.

March 2nd, 1905.

14.

THE MULTIPLICATION OF *TRYPANOSOMA GAMBIENSE* IN THE ALIMENTARY CANAL OF *GLOSSINA PALPALIS*.

By Lieutenant A. C. H. Gray, R.A.M.C., and Lieutenant F. M. G. Tulloch, R.A.M.C.

1. *Can the trypanosome of sleeping sickness multiply in the stomach of Glossina palpalis?*

The following is an outline of the experiments done to prove this. The flies used were brought in daily from the lake shore at Entebbe. It appeared that a dry atmosphere affected the

* *Cf.* Austen, "Monograph of the Tsetse-flies," p. 300.

AFRICA

SHOWING THE DISTRIBUTION OF THE

TSETSE-FLIES

AS AT PRESENT KNOWN.

Glossina tachinoides.

Glossina palpalis.

Glossina longipennis.

Glossina morsitans.

Glossina Fusca.

Glossina pallidipes.

Areas where two or more species have actually been found.

Gl. palpalis
" longipalpis
" fusca
" morsitans

Gl. palpalis
" morsitans
" longipalpis

Gl. palpalis
" fusca
" morsitans
" pallicera

Gl. palpalis
" fusca

Gl. morsitans
" pallidipes

Gl. palpalis
" morsitans
" longipalpis

Gl. fusca
" palpalis

Gl. fusca
" morsitans
" longipalpis
" palpalis

Gl. fusca
" palpalis

Gl. morsitans
" pallidipes

Gl. pallidipes
" fusca

Gl. longipennis
" fusca
" pallidipes

Gl. morsitans
" fusca
" pallidipes

Gl. morsitans
" fusca
" pallidipes

Gl. pallidipes
" fusca

vitality of the caged flies, and also had a marked effect on the length of time during which the trypanosomes survived inside them. To counteract this the flies, from the time they were brought in, were kept in cages, placed on a bed of absorbent paper, constantly saturated with water from a reservoir with a syphon attachment.

The flies were kept either 24 or 48 hours after they were brought in. They were then fed on monkeys infected from the cerebro-spinal fluid of sleeping sickness cases. These monkeys showed trypanosomes in varying numbers in a blood film, though never more than one trypanosome to six fields of a 2 mm. objective. Forty-eight hours later they were fed on a fresh normal monkey "A"; forty-eight hours later they were fed on another fresh monkey "B"; forty-eight hours later on monkey "C," and so on. This interval was selected, because from previous trials it seemed a natural one for the fly, and nearly all the flies would re-feed after 48 hours.

An enormous increase occurs sometimes in the number of trypanosomes taken in by the fly, so much so, that the blood in the intestine of the fly literally swarms with them. In this case the appearance of a fresh preparation can only be compared to a similar one made from the blood of a rat dying of Nagana, when the number of parasites equals that of red corpuscles.

This increase was first seen in flies 96 and 120 hours after infection, and was thought to occur first at these periods. Later on it was found that the same increase occurred, and that the same enormous numbers of trypanosomes were found 24 hours after the fly had fed on the infected animal.

When these flies were re-fed in the way described, each successive feed of blood seemed to act as a fresh supply of culture medium, and we have found these greatly increased numbers maintained up to 288 hours (12 days) after the infective feed. It is very probable, therefore, that the increase first found at 96 and 120 hours after infection was only the continuation of one which had occurred in the first 24 hours. After it had been found that this increase could occur in the first 24 hours, observations were made on two monkeys. When examined 24 hours after feeding this multiplication was observed in a total 10 per cent. of all the flies.

On some days a considerable number of flies would be examined, and the increase would not be found in any of them, though they were kept under the same conditions and fed on the same monkey, and though there was no perceptible difference, either in numbers or in morphology, of the trypanosomes as seen in a blood film. For instance, of the flies which fed on Monkey 350 on March 23rd, 5 out of 15 showed this great increase when examined 24 hours later. On the next day the increase was not seen in any of 29 flies examined. On the next day 18 negative flies were examined, and on the day following 10. Three days later, when another box of flies fed on the same monkey was examined, the increase was found in 2 out of 9 flies examined. This increase, which is found in 10 per cent. of flies

24 hours after feeding, is continued at later periods up to 288 hours, in a total of 5·6 per cent. of them. Probably if a much larger number of flies could be fed and examined, it would be found that the increase was continued in the same proportion of flies as showed it originally.

The proportion of male flies brought in is very much greater than that of females. This increase has, however, been observed in one female fly.

2. *What proportion of freshly-caught flies in the neighbourhood of Entebbe contain trypanosomes?*

The following method was used in order to try and find this out:—The flies were kept for 24 hours after they came in. They were then fed on an uninfected normal monkey. Twenty-four hours later they were dissected and examined for trypanosomes. Out of 200 flies examined up to the present, two contained in their intestines the same enormous numbers of trypanosomes as were found in 10 per cent. of flies which had been fed on an infected monkey 24 hours previously.

3. *Morphology of the trypanosomes seen in the fly.*

The forms of trypanosome seen in the fly vary from very small ones, some 20μ in length, to very long slender ones of about 100μ. The most striking variation from the ordinary form seen in the blood, however, is the different position of the micronucleus. This is very rarely seen at the extreme blunted end of the parasite. It varies from a position midway between the posterior extremity of the trypanosome and the macronucleus, to a position on the anterior or flagellar side, Figs. 1 and 2. In trypanosomes from the fly the most common positions for the micronucleus are, either anterior to the macronucleus or at the side of it. A very common dividing form is that seen in Fig. 3, which would give rise to two trypanosomes, one with an anterior micronucleus and the other with a micronucleus at the side of the macronucleus. The very small forms have been observed to be produced by unequal division of a large trypanosome, as in Fig. 4. No vacuole is seen in any of these trypanosomes. The blue-staining granules in the protoplasm are present as in the ordinary forms from the blood. What seems their natural method of progression is with the flagellum foremost. They then move very rapidly along a straight course, with only the flagellum and undulating membrane vibrating, the rest of the trypanosome having no lateral movement at all. They can also move with the blunt posterior extremity first, but in this case they move very slowly; their path is zig-zag instead of straight, and they advance by a series of contractions which bend one-half of their body at right-angles to the other. With greatly increased numbers of trypanosomes in a fly at any period after infection there is, in most cases, a large proportion of forms with

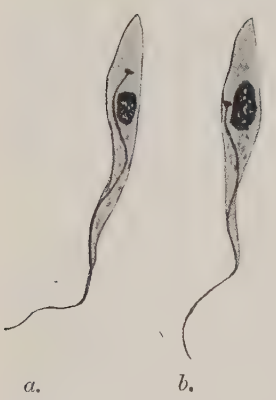


Fig. 1.

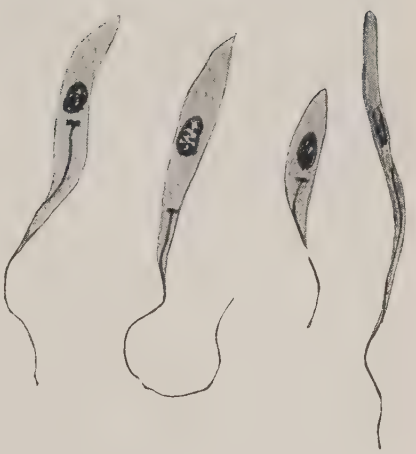


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1*a*. Trypanosome with micro-nucleus half way between blunted extremity and nucleus.
Fig. 1*b*. Trypanosome with micro-nucleus at side of nucleus.
Fig. 2. Forms with anterior micro-nuclei.
Fig. 3. Common dividing form.
Fig. 4. "Budding off" of one of the smallest forms.

anterior micronucleus. In some cases, however, all the trypanosomes found in a fly are practically normal in appearance, the micronucleus being near the posterior extremity. Of the two "fresh" flies which contained trypanosomes, one contained forms almost all of which had an anterior micronucleus, the other showed almost "normal" trypanosomes. Rosettes of trypanosomes have been seen in both fresh and stained preparations. In these rosettes the trypanosomes are joined directly by their posterior extremities; there is no central mass of protoplasm. They vary from very distinct rosettes of 4 to 7 trypanosomes to large loosely woven masses of 15 to 20, most of which are joined at their extremities, but some of which, either naturally, or in making the preparation, are a little separated and lie entangled among the others. When observed in a fresh preparation these rosettes become smaller from breaking away of some of the individuals; there is nothing in the nature of agglutination. In some rosettes every trypanosome belonged to the type in which the micronucleus is anterior. Other rosettes were composed of forms with the micronucleus either at the side of the nucleus or touching it posteriorly. One stained preparation showed a mass of trypanosomes visible with a hand lens. It consisted of a long strip of trypanosomes lying side by side, closely opposed to each other, and four or five deep. It had the appearance of a mass or colony formed by progressive multiplication. Several oval forms of trypanosome have been observed with a darkly staining blue protoplasm, macro- and a micronucleus. These oval forms frequently have a capsulated appearance, possibly due to the remains of the flagellum. In the examination of these flies the whole gut was dissected out in each case, and its various parts mixed with normal saline examined fresh. If examined soon after re-feeding the fly, the trypanosomes are confined to the dark, altered blood in the lower gut, but later on they swarm throughout the blood in the whole alimentary tract. As in the case with cerebro-spinal fluid or gland juice, the medium surrounding the trypanosomes in the fly was found to hinder staining of the chromatin. Accordingly films were made and fixed while still wet in osmic vapour. They were then treated with an application of fresh blood serum, as recommended by Lieut.-Colonel Leishman for sections containing trypanosomes. This was then washed off and they were stained by Leishman's stain. This method gives a very clear staining of the chromatin elements, and they are not obscured by the granules in the protoplasm, which stain a deep blue.

4. *Can infection be conveyed to an animal by inoculating these trypanosomes from the intestine of the fly?*

The following experiments have been done in connection with this point: Monkey 380 was injected with the intestinal contents of a fly which had been fed on an infected monkey 120 hours previously and re-fed in the usual way. This fly

contained enormous numbers of trypanosomes. The monkey was frequently examined, but never found infected. 49 days later the contents of 10 flies, which had fed 24 hours previously, were ejected. A drop of the fluid injected showed numerous active trypanosomes, but the monkey remained uninfected. Monkey 381 was inoculated with the contents of 20 flies which had been infected 96 hours previously (and re-fed). 49 days later the animal died. Its blood was frequently examined up to the time of death, but never showed trypanosomes. Death in this case was probably due to a long captivity. Monkey 382, a duplicate experiment to 381, has never shown trypanosomes. Monkey 395 was injected with the contents of 10 flies which had fed 24 hours previously. It died 21 days later, never having shown trypanosomes. Monkey 396 was inoculated with the contents of ten "24-hour" flies. This animal was also uninfected. The natural conclusion is, that infection cannot be produced by inoculation of trypanosomes from the intestine of the fly, and this same conclusion was arrived at by Colonel Bruce when experimenting with the trypanosome of Nagana.

5. *Can trypanosomes travel from the intestine to the salivary gland of the fly?*

1. The salivary gland of a fly which had been infected 144 hours previously (and re-fed as usual) was dissected out. This fly contained great numbers of trypanosomes in its intestine, many of them showed forms with an anteriorly placed micronucleus. The salivary gland, on examination, showed numbers of actively motile trypanosomes. On staining, most of these trypanosomes appeared to be the ordinary forms as seen in the blood, but there were a few forms similar to those seen in the gut.

2. In the "fresh" fly noted above, which contained numerous trypanosomes of almost the ordinary form in its gut, the salivary gland was also found to contain numbers of trypanosomes. The salivary gland was broken up in normal salt solution and injected into a monkey, but it had been kept for some time before this was done, and the trypanosomes had lost most of their activity. In a stained preparation these trypanosomes were like the forms ordinarily seen in the blood of man or injected animals. Up to the present, 15 days, this monkey has not shown trypanosomes. None of the series of monkeys on which the flies were re-fed has as yet shown trypanosomes.

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